RESOURCE ALLOCATION REVIEW

PART 1: TESTING THE APPROACH TO DISTRIBUTE 2020/21 GROWTH FUNDING

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1. Executive Summary

An allocation formula is currently used to distribute annual growth funding in Wales. Around £6.6bn[1] of funding per annum in Wales is allocated per annum to the seven health boards in Wales. Currently a funding formula (the "Townsend Formula") allocates the annual discretionary growth funding, with the remaining allocation rolled over from previous years. This formula allocates resources on a direct needs basis, which differs from many other countries, where typically funding is allocated based on more indirect measures of healthcare need, as part of more statistically involved approaches.

The Welsh Government is developing a new formula to allocate 2020/21 discretionary growth funding. The Welsh Government has prioritised developing a new needs based population formula to replace the Townsend Formula, including departing from the direct needs approach. In developing its new approach, the Welsh government has planned two phases of work, led by a Technical Advisory Group (TAG):

- Phase 1 – focussing on identifying an appropriate short run approach to allocate discretionary growth funding in the discretionary HCHSP budget for 2020/21 (the "Growth Formula"); and
- Phase 2 – developing, agreeing and implementing a new formula, to be used beyond 2020/21.

PA is supporting to review the Growth Formula, which is the first of three parts of work. PA Consulting was commissioned in June 2019 to support Phase 1 of the Resource Allocation Review. Specifically, PA is supporting across three parts, of which this report relates to Part 1: a critical friend review of the Growth Formula.

TAG has identified an approach for the Growth Formula, based on closely replicating the Scottish model. The Growth Formula is based on closely replicating the Scottish Resource Allocation Formula ("Scottish Formula"), using Welsh data and assumptions where possible. The Growth Formula uses a weighted capitation methodology to develop funding allocations. This involves allocating resources based on a per capita basis, before developing additional adjustments: age-sex cost index, capturing variation in service utilisation for different age / sex groups; an additional needs index, capturing further needs drivers over and above age and sex, e.g. morbidity and mortality; and an additional costs index, capturing unavoidable additional costs in rural areas.

A range of initial tests have been undertaken as part of the review, confirming that the Growth Formula is fit for purpose. A range of initial tests have been undertaken on the Growth Formula. Generally, the formula functions as intended by aiming to allocate resources to areas with the greatest need. For example, the Formula allocates a greater share of funding to more deprived areas. The Growth Formula also accounts for the three most common features across formulae internationally: population, demography and need.

Three deep dives have also been undertaken to further test specific components of the formula, resulting in a number of recommendations for TAG – which the Welsh Government is currently implementing. Deep dives have been undertaken to test:

1. The data sources used to capture the population;
2. The weight of the additional needs index – which uses LLTI and ASMR to capture morbidity and mortality; and
3. The potential evidence around whether the costs of delivering community services are higher in rural settings.

Working papers across each area have been drafted in the voice of the Welsh Government and discussed at the 25th July 2019 TAG meeting. Through the deep dives, a number of recommendations have been developed:

- Use 2020 population forecasts developed by the Welsh Government (and re-based in 2018 to reflect the observed population) to capture the population component;
- Apply an alternative weight for the overall LLTI and ASMR composite additional needs index to reflect the relationship between needs factors, ahead of feeding in to the Growth Formula; and
- Include an adjustment for excess community costs, based on a combination of Welsh data and Scottish inputs – subject to testing the appropriateness of applying Scottish data in the Welsh formula.

The Welsh Government is currently implementing these recommendations to the Growth Formula for Phase 1.

There are a number of components of the Growth Formula which could be further reviewed, particularly as part of Phase 2. The formula does not include adjustments for features included in some countries, such as addressing potentially unmet need; variations in input costs (supply side factors)[2]; and broader objectives around reducing health inequalities. A number of areas have been identified for further investigation as data becomes available and the formula is further developed in Phase 2, including the age-sex cost curves; drivers of healthcare costs more widely; supply side factors; and exploring the impact of multi-morbidity on additional needs.

[1] 2019/20 Total Revenue Resource Allocation – Total HCHS, Drug Prescribing and Primary Care Contracts Resource Limit (Welsh Government) https://gov.wales/sites/default/files/publications/2019-06/health-board-2019-20-allocations.pdf

[2] For example, local labour markets should not impact on staff costs as pay scales are set nationally for the Welsh NHS.

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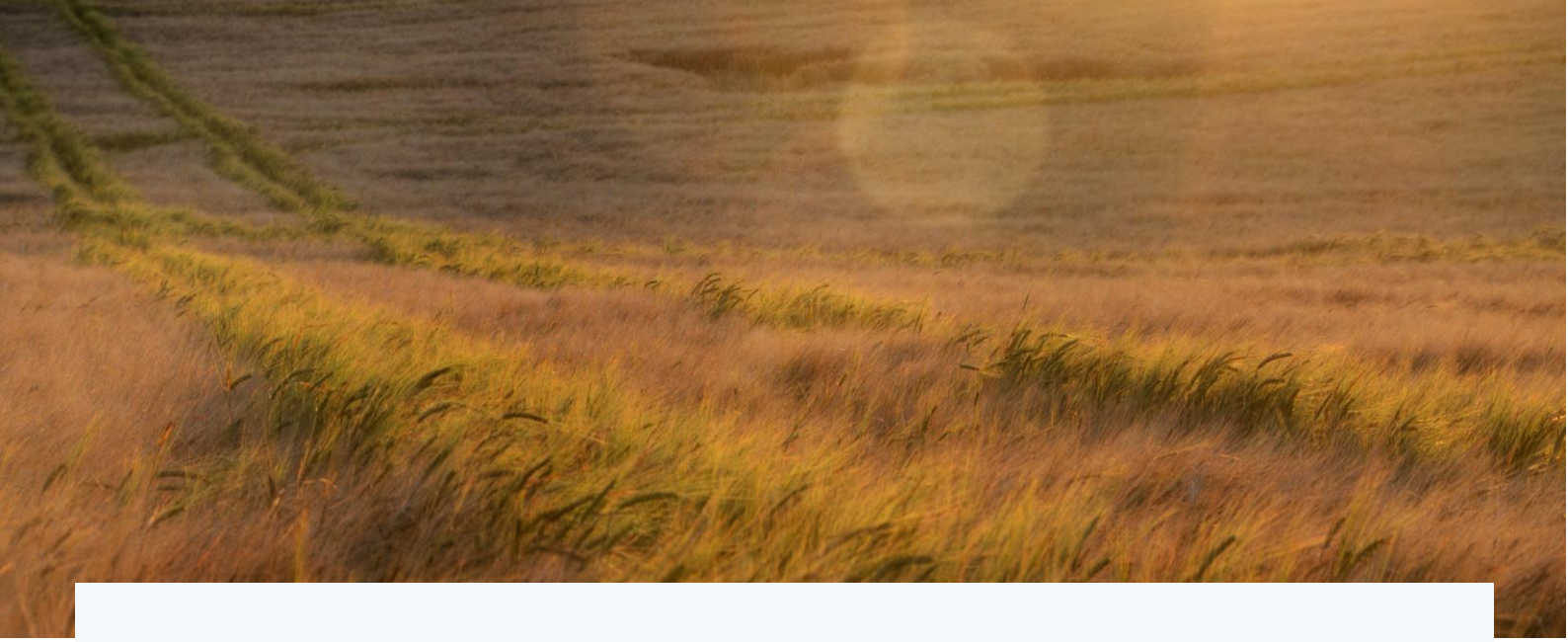


2. Background and context

This report reviews a number of elements of the proposed formula developed by the Welsh Government to allocate 2020/21 discretionary growth funding to its seven health boards. This review is part of a broader programme of work to reform healthcare allocations in Wales.

2.1. Introduction

Funding in the NHS is increasingly tight as demand continues to grow with an ageing population with multi-morbidities. In developed countries this is putting significant strain on fiscal expenditure. At the same time, there remain significant health inequalities, driven by a number of factors such as deprivation. These pressures are putting increasing strain on resource allocation methods, and their importance in ensuring that the marginal pound goes to those with the highest need.

Around £6.6bn[3] of funding per annum in Wales has been allocated for nearly 50 years on the basis of a mixed approach consisting of roll over of historical allocations and a funding formula for growth money. The formula has developed over time and been through a number of significant revisions. The approach adopted up to 2019/20 (the "Townsend formula") distributes c.£137m (2019/20) additional growth to the overall c. £4.6bn (2019/20) discretionary Hospital, Community and Health Services and Prescribing (HCHSP) funding to the seven Local health Boards (LHBs) in Wales, drawing on the work conducted by the Townsend Review (2000)[4] and further work by the Welsh Government. This formula allocates resources on a direct needs basis, which differs from many other countries, where typically funding is allocated based on more indirect measures of healthcare need, as part of more statistically involved approaches. Further, the formula is used to allocate only additional year on year growth monies to LHBs, with the remainder of LHBs' funding remaining the same as the previous year. This means that only a relatively small share of the total funding allocation is driven by the Townsend formula. This approach also differs from many other countries, where typically a formula is used to allocate the majority of monies.

The formula has subsequently been revisited in response to a Public Accounts Committee recommendation in 2013 to review the basis of allocations.[5] Whilst the overall formula has evolved over the years the fundamental approach has not varied significantly. In 2017 the Auditor General made a specific recommendation for the Welsh Government:

'We recommend that the Welsh Government swiftly completes the review of its funding formula for health boards to ensure that variations in funding levels properly reflect differences in population health needs and other determinants of healthcare costs'. [6]

In response, the Welsh Government has prioritised developing a new needs based population formula to replace the Townsend formula, including departing from the direct needs approach. In developing its new approach, the Welsh government has planned two phases of work, led by a Technical Advisory Group (TAG):

[3] 2019/20 Total Revenue Resource Allocation – Total HCHS, Drug Prescribing and Primary Care Contracts Resource Limit (Welsh Government) https://gov.wales/sites/default/files/publications/2019-06/health-board-2019-20-allocations.pdf
[4] www.assembly.wales/3b46ecea0008722e0000348700000000.pdf
[5] http://www.assembly.wales/Laid%20Documents/GEN-LD9729 - Welsh Government Response To The National Assembly For Wales Public Accounts Committee Report On H-15042014-255488/gen-ld9729-e-English.pdf
[6] http://senedd.assembly.wales/documents/s64994/Auditor General for Wales Report – Implementation of the NHS Finances Wales Act 2014 – 7 July 2017.pdf

- Phase 1 – focussing on identifying an appropriate short run approach to allocate discretionary growth funding in the discretionary HCHSP budget for 2020/21 (the "Growth Formula"); and
- Phase 2 – developing, agreeing and implementing a new formula, to be used beyond 2020/21.

2.2. The proposed Growth Formula

TAG has undertaken a desktop review of international approaches. Based on this review, an approach for the Growth Formula has been identified, based on closely replicating the Scottish allocation formula and using Welsh data and assumptions where possible.

The Scottish Resource Allocation Formula ("Scottish Formula") has been identified as an appropriate starting point by TAG, for a number of reasons.

- **Up to date.** The Scottish Formula has been continually developed and regularly reviewed over the years.
- **Transparency.** Details of the structure and spreadsheets for each component are publicly available and relatively transparent.
- **Comparability.** The structure of the NHS in Scotland is similar to Wales with integrated health boards commissioning and delivering services.
- **Flexibility.** The formula is modular allowing for flexibility over which components are included based on applicability to Wales and the availability of data.
- **Granularity.** The formula operates at board and lower geographical levels.

Following successful high-level testing of the Scottish Resource Allocation Formula, TAG further developed and tested the formula and component parts – including population shares, age-sex cost weights, additional needs and additional costs due to rurality – in detail during 2019.

2.3. This report

PA Consulting was commissioned in June 2019 to support Phase 1 of the Resource Allocation Review. Specifically, PA is supporting across three parts:

- Part 1, covered by this report, comprises a critical friend review of the Growth Formula to date;
- Part 2 will reconsider more fully the overall methodology used to allocate funding post 2020/21; and
- Part 3 will develop a roadmap to support the implementation of a new formula.

This report focusses on assessing the overall logic of the formula developed and various deep dives identified by the Welsh Government. This has been undertaken in the following context:

1. The size of total growth monies is determined independently from allocation shares, and is not part of the review;
2. The growth funds are smaller when compared to the overall allocation, in 2019/20 discretionary growth funds were c.£137m versus a total allocation of £6,559m[7];
3. The review has been undertaken in a time compressed period and has focussed on recommendations which could be implemented in short order by the Welsh Government; and
4. The review focusses on the Welsh approach and how this compares to the Scottish Formula, rather than appraising the Scottish Formula and its appropriateness or selecting any alternative approaches.

The integrity of individual calculations and the underlying models developed by the Welsh Government have not been considered as part of this review.

A series of working papers for TAG drafted in the voice of the Welsh Government, across the three deep dive areas, are included in Annex B.

The remainder of this report is organised as follows:

- Section 3 describes the overall approach to developing the Growth Formula;
- Section 4 undertakes initial testing of the Growth Formula;
- Section 5 summarises deep dive areas which have been explored;
- Section 6 develops conclusions and next steps; and
- Section 7 contains a number of supporting annexes.

[7] https://gov.wales/sites/default/files/publications/2019-06/health-board-2019-20-allocations.pdf

3. Approach to developing the Growth Formula

The Growth Formula is based on closely replicating the Scottish Formula[8], using Welsh data and assumptions where possible. This chapter provides an overview of the approach to develop the Growth Formula, focussing on how this differs from the Scottish Formula.

3.1. Weighted capitation approach

The Growth Formula uses a weighted capitation methodology to develop funding allocations. This involves allocating resources based on a per capita basis (step 1), before developing a number of additional adjustments (steps 2, 3 and 4) to reflect greater need, including age, sex and level of deprivation (see **Figure 1**).

Figure 1: Overall approach to developing the Growth Formula

The specific adjustments include:

- **Age-sex cost index**, capturing variation in service utilisation for different age / sex groups;
- **Additional needs index**, further needs drivers over and above age and sex, such as morbidity and mortality; and
- **Additional costs index**, unavoidable additional costs of providing services based on rurality.

Each of the adjustments comprise of indices, constructed relative to the country average, and developed separately, before feeding into the overall Growth Formula.

Different variants of the Growth Formula are developed for the various 'care programmes' that sit within the discretionary HCHSP budget; acute care, community care, maternity and prescribing. This approach allows the series of adjustments to be different for particular care programmes, for example the age and sex profile of populations are likely to be different for acute, community and maternity services. The care programmes are combined to produce an overall allocation share, weighted by each programme's share of expenditure (see Table 1). Other allocations, for example ring fenced and directed expenditure allocations and primary care allocations, are outside the scope of the Growth Formula and are not considered in this report.

Table 1: Expenditure weights by care programme based on 2017/18 expenditure

Care programme	Expenditure	
	(£m)	(%)
Acute	3,448	72.2%
Community	641	13.4%
Prescribing	523	11.0%
Maternity	163	3.4%
Total HCHSP	**4,774**	**100%**

WCR1 – Welsh Costing Return 2017/18

The rest of this chapter considers the four components of the Growth Formula in turn. Additional technical detail is provided in Annex A.

[8] https://www.isdscotland.org/Health-Topics/Finance/Resource-Allocation-Formula/information.asp

3.2. Share of population

The first step is to apply a population measure. The Growth Formula currently applies Office for National Statistics (ONS) mid-year population estimates by Local Authority. Mid-year estimates are published each year for the previous year and the most recent estimates are for 2018.

The Scottish Resource Allocation Formula uses population forecasts, re-based using the most recent mid-year population estimates. This provides forward looking estimates of the population size, age and sex profile, while re-basing helps to reduce forecast error.

Section 5 investigates the source of population information in the Growth Formula.

3.3. Age-sex cost index

For the Acute care programme, the age-sex cost index is estimated based on analysis by the Health Foundation in The Path to Sustainability report, which uses 2014/15 reference cost data.[9] In common with many other countries, detailed and robust cost information is not currently available to underpin similar analysis for other care programmes (Community, Maternity and Prescribing). As a result, the age-sex index for these services has been developed based on the Scottish Formula, rather than using Welsh data.

3.4. Additional needs index

Additional needs indices capture further drivers of need, over and above age and sex, such as morbidity and mortality rates. A Common set of additional needs indicators are developed for the Acute, Community and Prescribing care programmes, with separate indicators developed for the maternity component.

3.4.1. Acute, Community and Prescribing programmes

Additional needs for the Acute, Community and Prescribing programmes are driven by variation in the levels of morbidity and excess mortality across populations. These are captured in the Growth Formula by an index combining the age-standardised limiting long-term illness rate (LLTI) and age-standardised mortality rate for those under the age of 75 (ASMR<75). This is the same set of indicators identified in the Scottish Formula, following review of a broad range of potential indicators.

Although the indicators are the same between the Growth Formula and the Scottish Formula, the way the additional needs index is constructed and feeds in to the overall formula differs between the two.

In particular, the Welsh Growth Formula makes two main assumptions when inputting the indices in to the formula:

1. **Weight of individual index values**. The two indices (ASMR and LLTI) have the same weight (i.e. a simple average is taken of the two index values for each Local Authority), when combined to generate an overall composite index. The Scottish formula weights the individual indices based on a statistical method (calculating z-scores).[10]
2. **Weight of the overall composite index**. The resulting composite index is combined directly with the other components of the formula, without any weighting adjustment. In contrast, the Scottish approach uses regression analysis to estimate the relationship between the additional needs indicators and the other components of the formula.[11]

Further detail on the construction of the additional needs index is provided in Annex A and TAG papers RAR050 and RAR055 in Annex B.

3.4.2. Maternity programme

For the Maternity programme, the drivers of health need are different as the nature of the service and patient characteristics are different from general acute healthcare. Maternity services manage and treat conditions related to pregnancy among women between the ages of 15 – 49. The key drivers of additional need for these services are the number of births and the health of the mother and baby.

The additional needs index in the Growth Formula captures these through the birth rate and the proportion of births with low birth weight, respectively. Low birth weight is linked to a range of lifestyle factors in mothers (e.g. smoking and obesity) which are associated with more complicated pregnancies.

The Scottish Formula uses mean house price as a proxy of deprivation and additional need in Maternity programmes. The TAG meeting on 25th July 2019 considered the merits of using low birth weight in place of mean

[9] https://www.health.org.uk/publications/reports/the-path-to-sustainability

[10] The Scottish formula standardises the two indicators by calculating z-scores for each area and adding them together. Z-scores make it easier to compare values across different variables by standardising their distributions and expressing values in terms of the deviation from the mean (in terms of standard deviations).

[11] The Scottish approach uses regression analysis to determine the relationship between the sum of LLTI and ASMR<75 z scores and the variation in cost which cannot be explained by the size, age and sex profile of the population for various diagnosis groups (measured as observed costs divided by population age-sex expected costs). The results of regression analysis give an estimate of the relationship between the additional needs indicators sum of z-scores and relative healthcare need. The additional needs index is constructed as the predicted values from the regression based on each area's sum of z-scores. This is averaged across diagnosis groups weighted by the share of expenditure.

house price in the Growth Formula based on evidence presented in RAR051.[12] It was agreed that the proportion of births with low birth weight is a more suitable indicator in Wales given the more direct link with additional need.

3.5. Additional costs index

While there are a number of adjustments included in the Scottish Formula to capture further additional costs (referred to as "unavoidable excess costs" in the Scottish Formula) – covering both acute and community services – currently no further adjustments have been included in the Growth Formula. This contrasts with many formulae in other countries which look to account for supply side factors, such as higher costs due to input price differences (e.g. the Market Forces Factor in England).

The adjustments included in the Scottish Formula focus on the potential additional costs of providing healthcare services in rural areas, particularly for travel based community services. Section 5 investigates this issue further.

[12] RAR051 – Maternity Component – Population and additional needs

4. Initial tests

This chapter summarises a range of initial tests undertaken on the Growth Formula, focussing on comparing the potential allocation shares to those implied by the Townsend Formula; various other tests; and well as potential areas for future development. Areas for immediate improvement have been investigated separately in the deep dive chapter which follows.

4.1. Comparison to shares of growth allocation under Townsend formula

In order to test the materiality of potential changes to allocations, the funding shares implied by the Growth Formula have been compared to the 2019/20 shares implied by the Townsend Formula.

The overall pattern of allocations distributed across health boards is consistent across the work in progress model outputs and Townsend outputs. However, there are nuances for individual boards which lead to differences of up to 1% of growth monies which could materially impact allocations (up to c.£1m).

The 2017 Zero Based Review found demographic differences which were not reflected in existing allocations, could be driving higher relative costs of delivering healthcare.[13] The Growth Formula accounts for variation in health need by age group directly through the age-sex cost index. The more appropriate reflection of relative healthcare need by age group in the Growth Formula can explain the differences with the Townsend Formula.

4.2. Comparison to other international resource allocation formula

The Scottish Formula, which forms the basis of the Growth Formula, is largely representative of other weighted capitation resource allocation formulae. Common features across international examples include their consideration of population, demography and need. A range of additional adjustments are made in other countries' formulae (see Table 2).

Table 2: Components of the Scottish Resource Allocation Formula compared to international examples

	Component	Growth Formula (as of June 2019)	Scottish Formula	Common across international models	Included in some countries
Needs	Population	✓	✓	✓	
	Demography	✓	✓	✓	
	Needs drivers	✓	✓	✓	
	Unmet needs				✓
	Ethnicity and other patient groups				✓
	Overseas visitors				✓
	Further reduction in health inequalities				✓
Cost / supply factors	Rurality / remoteness	*Separate adjustment for acute*	✓		✓
	Market Forces Factors (input prices)		✓		✓

Source: Scotland, England, Northern Ireland and New Zealand allocations[14] , 2013 Comparative Analysis of Seven Models[15]

The Growth Formula accounts for the three most common features; population, demography and need. However, the formula does not include adjustments for the other features included in some countries, such as addressing

[13] http://www.wales.nhs.uk/sitesplus/documents/862/Item 2.6 Report of the Chief Executive1.pdf
[14] Scotland: https://www.isdscotland.org/Health-Topics/Finance/Resource-Allocation-Formula/
England: https://www.england.nhs.uk/allocations/
Northern Ireland: https://www.health-ni.gov.uk/topics/dhssps-statistics-and-research/resource-allocation
New Zealand: https://www.health.govt.nz/new-zealand-health-system/key-health-sector-organisations-and-people/district-health-boards/accountability-and-funding/population-based-funding-formula
[15] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4225752/

potentially unmet need; variations in input costs[16]; and broader objectives around reducing health inequalities. An adjustment for rurality in community services is further investigated in the deep dives in Section 5.

4.3. Comparison of Welsh and Scottish age-sex cost weights

The age-sex index for non-acute services has been developed based on the Scottish Formula, rather than using Welsh data. This assumes that the weighted cost shares between age-sex groups in Wales are similar to Scotland.

This assumption has been tested using information from the Acute programme – where both Scottish and Welsh data are available. Table 3 compares the implied growth shares based on population and age-sex weightings using Welsh cost curves estimated by The Health Foundation (2014/15) and cost information from Scottish allocations. The shares are close – within 0.1% – across the methodologies, for all Local Authorities. This suggests that, in the absence of specific data for Wales, the Scottish cost weightings for Community, Prescribing and Community are likely to provide a reasonable approximation for Welsh age-sex cost weights.

Table 3: Comparison of Acute age-sex weighted cost shares using Welsh vs Scottish data

Local Authority	Age-sex weighted cost shares	
	Based on Welsh reference costs	Based on Scottish cost weights
Isle of Anglesey	2.5%	2.5%
Gwynedd	4.1%	4.1%
Conwy	4.3%	4.3%
Denbighshire	3.3%	3.3%
Flintshire	5.0%	5.0%
Wrexham	4.2%	4.3%
Powys	4.8%	4.8%
Ceredigion	2.5%	2.5%
Pembrokeshire	4.4%	4.4%
Carmarthenshire	6.4%	6.3%
Swansea	7.6%	7.6%
Neath Port Talbot	4.6%	4.6%
Bridgend	4.6%	4.6%
Vale of Glamorgan	4.2%	4.2%
Cardiff	9.8%	9.9%
Rhondda Cynon Taf	7.3%	7.4%
Merthyr Tydfil	1.8%	1.9%
Caerphilly	5.6%	5.6%
Blaenau Gwent	2.2%	2.2%
Torfaen	2.9%	2.9%
Monmouthshire	3.3%	3.3%
Newport	4.5%	4.5%

The Health Foundation[17], Welsh Government KAS analysis of ONS population data and Scottish costs (RAR09)

For the Prescribing programme, TAG also considered using English data to establish age-sex cost weights. Welsh Government Knowledge and Analytical Services (KAS) tested the impact of using English and Scottish data on

[16] For example, local labour markets should not impact on staff costs as pay scales are set nationally for the Welsh NHS.
[17] https://www.health.org.uk/publications/reports/the-path-to-sustainability

Local Health Board shares in RAR041.[18] This also showed a minimal difference between approaches. Scottish information was preferred as the basis for age-sex weights in the Growth Formula for Prescribing as it better accounts for very high cost drugs.

4.4. Alternative options for additional needs indices

TAG considered a range of alternative indicators of additional needs alongside LLTI rate (from census data) and ASMR<75. These included:

- Preventable mortality
- Amenable mortality
- Avoidable mortality
- Limiting long-term conditions from survey data
- All cause death rate
- Cancer incidence rate
- Years of life lost
- Low weight single births

TAG considers that there is a rationale for the use of LLTI and ASMR<75 as the two additional needs indicators. This approach also maintains consistency with the Scottish Formula. The use of LLTI and age-standardised mortality for under 75s was also preferred as these indicators help to capture both morbidity and mortality, respectively, two important underlying needs drivers.

TAG also concluded that many of the other factors considered were either not sufficiently robust, e.g. based on survey data or small sample sizes, or not available at lower level geographies.

Further work on additional needs should explore how well variation in the additional needs index reflects the level of co-morbidity between populations. Recent work in Cwm Taf Morgannwg has identified the number of co-morbidities as the key driver of rising costs for the health board.[19] Limiting long-term illness rate captures variation in morbidity but not nuances in the number or type of long-term conditions prevalent in the population. Investigation into the prevalence of higher cost conditions and the number of co-morbidities would help determine how well the additional needs index reflects this variation between areas.

4.5. Testing the index components against local characteristics

A sense check of the variation in the additional needs index has also been undertaken. In particular, a comparison of the additional needs index at lower super output area (LSOA) level to deprivation deciles showed a clear link between the level of deprivation (implied by the Welsh Index of Multiple Deprivation) and the level of additional needs implied by the Growth Formula. This provides a level of confidence that the additional needs index will help to allocate greater resources to more deprived areas.[20]

Table 4: Acute age-sex cost index and additional need index by Welsh Index of Multiple Deprivation decile

WIMD decile	Age-sex cost index	Additional needs index (unweighted)
10 per cent most deprived	0.86	1.53
10-20 per cent most deprived	0.91	1.33
20-30 per cent most deprived	0.96	1.21
30-40 per cent most deprived	0.99	1.11
40-50 per cent most deprived	1.00	1.00
40-50 per cent least deprived	1.03	0.93
30-40 per cent least deprived	1.06	0.85
20-30 per cent least deprived	1.04	0.81
10-20 per cent least deprived	1.07	0.77
10 per cent least deprived	1.07	0.66

Welsh Government KAS analysis presented in Technical Advisory Group paper RAR035

[18] KAS analysis presented in Technical Advisory Group paper RAR041 – Prescribing Component – Update.
[19] Masterclass on Population Health Management in Cwm Taf Morgannwg
[20] Note this comparison uses the unweighted additional needs index. However, any of the proposed weightings would maintain the order between deciles but reduce the variation around 1. For example, a 0.5 weighting would make the additional needs index for the 10% most deprived areas 1.27 and for the 10% least deprived 0.83.

A further sense check has been undertaken to test additional needs and age sex indices in rural / urban areas. Generally, the level of deprivation in rural areas tends to be lower than in urban areas. This would result in the additional needs index shifting resources towards more urban, deprived areas. However, populations in rural areas tend to be older which also results in higher healthcare need – and greater resources distributed in the Growth Formula through the age-sex component.[21] These hypotheses are evident in the initial data included in the initial Growth Formula (Table 5). In particular, comparing the age-sex index and additional needs index for urban-rural areas suggests higher relative need due to demographics in rural areas as expected, which is offset by a lower additional needs index.

Table 5: Acute age-sex cost index and additional need index by Rural-urban Classification

Rural-urban classification	Age-sex cost index	Additional needs index (unweighted)
Urban city and town	0.96	1.06
Urban city and town in a sparse setting	0.94	1.02
Rural town and fringe	1.02	1.00
Rural town and fringe in a sparse setting	1.16	0.93
Rural village and dispersed	1.10	0.81
Rural village and dispersed in a sparse setting	1.15	0.80
Rural town and fringe in a sparse setting	1.16	0.93

Welsh Government KAS analysis presented in Technical Advisory Group paper RAR035

4.6. Areas identified for future development

During testing, a number of areas have been identified for further investigation as data becomes available and formula is developed further during Phase 2:

- **Updated age-sex cost curves for each of the four Programmes of Care** – drawing on Welsh data where possible for each of the care programmes;
- **Explore drivers of healthcare costs** – supported by more granular and robust costing information;
- **Consider supply side factors** – such as higher costs due to input price differences, which are currently not included in the Growth Formula; and
- **Explore the impact of multiple co-morbidity on additional needs** – rather than the LLTI which indicates only whether populations have one or more long term conditions.

[21] https://www.nuffieldtrust.org.uk/files/2019-01/rural-health-care-report-web3.pdf

5. Deep dive areas

Following the initial review and testing of the Growth Formula, three deep dives have been undertaken to further test specific components of the formula:

1. The data sources used to capture the population;
2. The weight of the additional needs index; and
3. The potential evidence around whether the costs of delivering community services are higher in rural settings.

Working papers across each area have been drafted in the voice of the Welsh Government and discussed at the 25th July 2019 TAG meeting (included in the Annex). Through the deep dives, a number of areas have been identified for further consideration in the short term. This next section provides a summary of the deep dive findings, recommendations and TAG actions.

5.1. Population estimates vs population projections

As part of the allocation formula, there are a number of options for how to source population data, such as either using observed populations or forecasts. Currently the Growth Formula uses observed 2017 population statistics. These have been superseded recently by 2018 mid-year estimates as of July 2019. While this measure reflects the most recent and accurate estimates of population size and demographics, it does not account for expected changes in population dynamics, such as future demographic growth and changes in the age structure of local authorities. The formula may therefore benefit from instead applying population projections, which aim to reflect these dynamics.

For the Growth formula, TAG paper RAR049 therefore recommends for consistency to other formulae (including the Scottish model), that 2020 population forecasts developed by the Welsh Government (and re-based in 2018 to reflect the observed population) are used to capture the population component. Using population forecasts can help to account for expected changes in population dynamics, such as future demographic growth and changes in the age structure of local authorities. In addition, re-basing the forecasts also helps to ensure the projections use the latest data available. The Townsend formula was also challenged for not building in population projections; and the recommended approach could therefore help to address this.

Initial testing of the materiality of the adjustment in the paper suggests that the potential update is unlikely to materially impact overall health allocations, given the formula currently distributes only additional growth monies.

The Welsh Government has actioned the recommendation to apply 2020 population projections re-based to the most recent mid-year estimates in the Growth Formula following the TAG meeting on 25th July 2019.

TAG paper RAR049 is included in the annex.

5.2. Additional needs index

The Growth Formula uses the same combination of additional needs indicators as the Scottish Formula (LLTI and ASMR). However, the application of these indicators to form an additional needs index varies.

Two main lines of enquiry are explored in the deep dive and associated TAG paper RAR050:

1. **Weight of individual index values**. The two indices (ASMR and LLTI) have the same weight (i.e. a simple average is taken of the two index values for each Local Authority), when combined to generate an overall composite index. The properties of the individual indices have been explored, such as the distribution of the indices and the relationship between them. A number of different weights have also been tested. The indices are highly correlated, which suggests that different weights are unlikely to have a material impact. The paper therefore states it is difficult to justify an alternative weighting to the current assumption of a simple average.

   The Welsh Government has actioned the agreed approach of equal weights on ASMR and LLTI in the additional needs index following the TAG meeting on 25th July 2019.

2. **Weight of the overall composite index**. The resulting composite index is combined directly with the other components of the formula, without any weighting adjustment. This implies that there is a one to one relationship between the additional needs index and the other components of the formula. This is a different approach to the Scottish model, where the index is weighted implicitly as part of its overall econometric analysis. The econometric analysis in Scotland found a one unit increase in the additional needs index (constructed as sum of z scores) is related to between 0.03 and 0.15 increase in the cost ratio. This is used to weight the needs index as it feeds into the model. This precedent as well as simple econometric analysis undertaken to support the TAG paper justifies an alternative weighting to one to one when feeding in to the overall Growth Formula. However, the paper notes that further work is needed in order to develop specific weightings which may be appropriate.

TAG paper RAR055 explores five options for the weighting based on evidence from other countries and refinement of the simple econometric analysis. The TAG discussion was supported by supplementary work by the Welsh Government which tested the options against deprivation deciles and showed a weighting of 0.4 or higher distributes additional resource per head to areas with higher deprivation.

TAG endorsed a weighting of 0.6 to acknowledge the available evidence and reflect nuance in policy priorities around health inequalities and deprivation.

The Welsh Government has actioned a weighting of 0.6 on the additional needs index following the TAG meeting on 10th September 2019.

TAG papers RAR050 and RAR055 are included in the annex.

5.3. Additional costs of providing home-visit community services in rural settings

Although not currently included in the Welsh Growth Formula, many allocation formulae (including the Scottish Formula) include adjustments to account for additional travel costs associated with serving more dispersed and rural population. However, the evidence is limited around whether these costs do exist and the actual scale of impact.

For the Growth Formula, TAG paper RAR048 recommends – for consistency to other formulae (including Scotland and Northern Ireland) – that an adjustment for excess community costs is included. However, the paper states that this should be reappraised in Part 2.

There is limited information available to develop an adjustment. As such, the paper recommends that the adjustment combines readily available Welsh travel time information with Scottish input assumptions. In particular, the recommended adjustment uses Welsh travel time data from WIMD, and inputs from the Scottish formula describing the average time spent travelling for community services to derive the additional costs component. Scottish data is readily available and appropriate given the overall approach to replicating a number of elements of the Scottish model in the Growth Formula.

Further work by the Welsh Government to test the appropriateness of the Scottish input assumptions did not find any alternative assumptions. However, the Scottish inputs around workload are likely to provide a reasonable approximation for the purposes of this adjustment, unless there are large and fundamental differences in the delivery model for community services compared to Scotland – for example significantly different average contact times for home visits. In addition, initial testing of the materiality of the adjustment suggests that this is unlikely to materially impact overall health allocations, given the formula currently distributes only additional growth monies. Developing alternative input assumptions will require a sample collection of information which is not currently collected, for example by running an audit of services over a time period.

The paper undertakes a further analysis using the Scottish formula to test the potential impact of introducing its community services excess costs component. This analysis suggests that upon introducing the addition costs component, individual Scottish health boards' shares changed by less than 0.1% of total allocation, with the exception of the Scottish Highlands which increased by c. 0.2% after the adjustment was introduced. Given the more extreme rurality of the Scottish Highlands compared to rural areas in Wales, it is expected that a similar adjustment in Wales based on a common methodology would likely have a smaller impact on funding allocations (compared to no adjustment).

The Welsh Government has actioned the approach set out in RAR048 using Welsh travel time data from WIMD and Scottish input assumptions following the TAG meeting on 10th September 2019.

TAG paper RAR048 is included in the annex.

6. Conclusions and next steps

There are a number of conclusions from the review of the Growth Formula. These are made in the context of the use of the formula and wider review which will subsequent be undertaken.

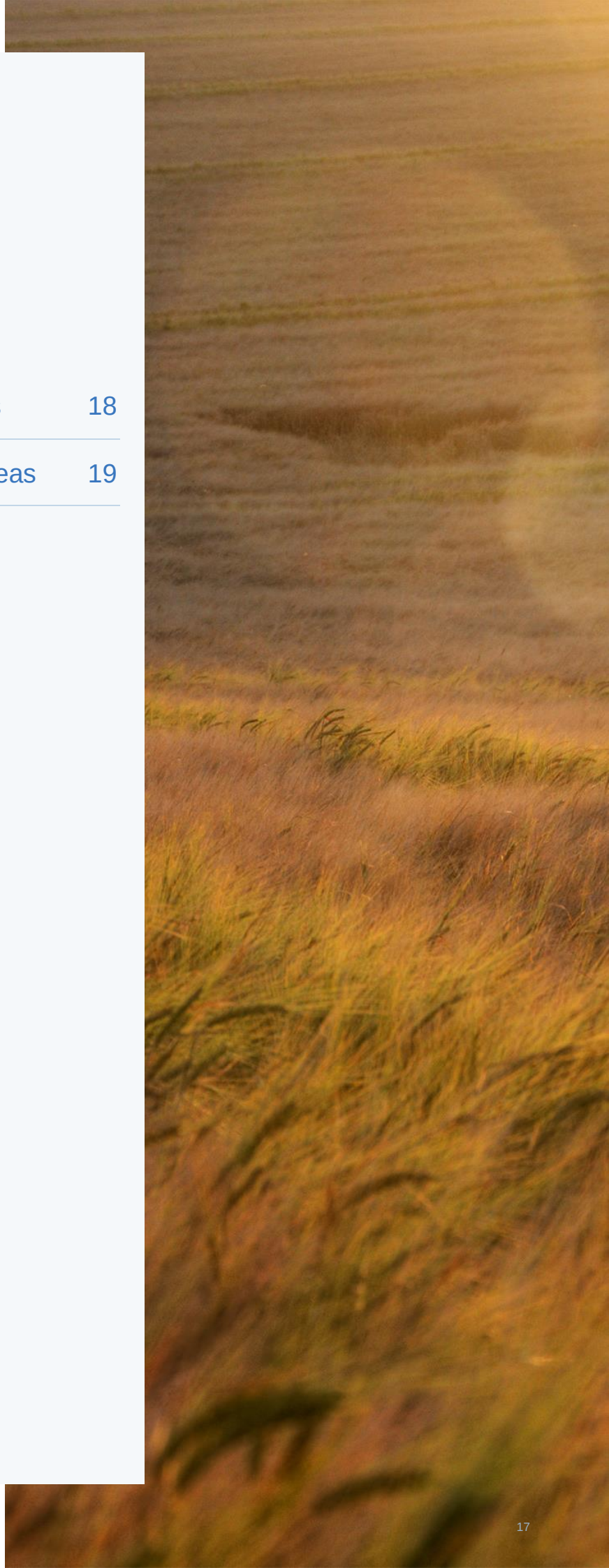
- **The Scottish formula is reasonable basis for developing the Growth Formula, but should be further considered in the wider review**. The Scottish Formula provides a reasonable basis for the development of the Growth Formula, given the consistency with international evidence and relative similarities between central health service structures and population characteristics across Scotland and Wales.
- **The Growth Formula is an appropriate means to allocate discretionary growth money in 20/21.** The Growth Formula captures key drivers of variation in healthcare need across Local Authorities, including many of the drivers used in other countries' formulae – such as the relationship between age / sex and cost as well as other needs drivers.
- **TAG has developed an evidence base to underpin the Growth Formula**. Through a series of working papers and materials, TAG has developed an evidence base around the development of the Growth Formula – such as the evidence around the use of LLTI and ASMR. This is supported by comparisons of data, indices and outputs.
- **A number of recommendations have been actioned to improve the formula**. There are recommendations related to the three deep dive areas developed by the Welsh Government for TAG:
    1. That 2020 population forecasts developed by the Welsh Government (and re-based in 2018 to reflect the observed population) are used to capture the population component;
    2. Additional needs -
        a. That an equal weight between LLTI and ASMR is used to capture additional needs;
        b. That a weighting of 0.6 is applied to the overall additional needs component as it feeds into the Growth Formula, to reflect international evidence and policy priorities to address health inequalities; and
    3. That an adjustment for excess community costs is included.

6.1. Next steps

Next steps include:

- Developing Part 2, focussed on reconsidering more fully the overall methodology used to allocate funding post 2020/21;
- Developing the age-sex cost curves for each of the four Programmes of Care;
- Exploring drivers of healthcare costs more widely;
- Considering supply side factors; and
- Exploring the impact of multiple co-morbidity on additional needs across care settings.

ANNEXES



A. Calculation of index components

This section provides details of the formula used in the calculation of the three indices used to adjust the population share in the Growth Formula.

Age-sex cost index

$$Age-sex\ cost\ index\ for\ LA_A = \left(\frac{\sum(LA_A\ Population_i\ \times Average\ cost_i)}{LA_A\ Population}\right) \div Wales\ average\ cost\ per\ capita$$

$$where\ i\ is\ each\ age-sex\ group$$

Additional needs index

The Growth Formula and Scottish Resource Allocation Formula take different approaches to construct the additional needs index from the indicators of additional need (age-standardised limiting long-term illness rate and age-standardised mortality rate for those under the age of 75).

Additional needs index in the Growth Formula

$$Additional\ needs\ index\ for\ LA_A = \left(\frac{LA_A\ ASMR < 75}{Wales\ average\ ASMR < 75} + \frac{LA_A\ LLTI}{Wales\ average\ LLTI}\right) \div 2$$

Additional needs index in the Scottish Formula

The Scottish Resource Allocation Formula uses regression analysis at a small area level (intermediate data zones) to determine the relationship between the sum of LLTI and ASMR<75 z scores and the variation in cost which cannot be explained by the size, age and sex profile of the population for various diagnosis groups (measured as observed costs divided by population age-sex expected costs), used as a proxy for additional needs.

The z-score on the LLTI rate of area A is calculated as:

$$Area_A\ LLTI\ z\ score\ = \frac{Area_A\ LLTI\ - Average\ \ LLTI}{Standard\ deviation\ of\ LLTI}$$

The variation in cost which cannot be explained by the size, age and sex profile of the population for various diagnosis groups is used as a proxy for additional needs:

$$Additional\ needs\ index\ of\ Area_A = \frac{Actual\ costs\ of\ Area_A}{Age-sex\ expected\ costs\ of\ Area_A}$$

The regression model can be expressed through the following simple formula:

$$\frac{Actual\ costs\ of\ Area_A}{Age-sex\ expected\ costs\ of\ Area_A} = c + \beta \times (Area_A\ LLTI\ z\ score + Area_A\ ASMR < 75\ z\ score) + \varepsilon$$

The results of regression analysis give an estimate for the value of the constant, c and the coefficient on the sum of z-scores, β. The additional needs index for area A is based on the regression prediction, denoted as:

$$Additional\ needs\ index\ of\ Area_A\ = \hat{c} + \hat{\beta} \times (Area_A\ LLTI\ z\ score + Area_A\ ASMR < 75\ z\ score)$$

Additional cost index for community services

$$Additional\ cost\ index\ for\ LA_A$$
$$= \%\ home\ visits\ \times \left(\frac{Contact\ duration + Set\ up\ time + LA_A\ WIMD\ Access\ to\ GP\ travel\ time}{Contact\ duration + Set\ up\ time + Average\ WIMD\ Access\ to\ GP\ travel\ time}\right)$$
$$+ \%\ non\ home\ visits$$

B. Working papers on deep dive areas

Working papers on each of the three deep dive areas were drafted in the voice of the Welsh Government and discussed with the Technical Advisory Group on 25th July 2019. The TAG papers as discussed are included in this section.

1. The data sources used to capture the population (RAR049 – Testing the population data used);

2. The weight of the additional needs index (RAR050 – Testing the additional needs indicators); and

3. The potential evidence around whether the costs of delivering community services are higher in rural settings (RAR048 – Testing the differential costs across community services).

Further work on additional needs component weighting was identified based on findings of RAR050. A working paper considering a range of options was drafted in the voice of the Welsh Government and discussed with the Technical Advisory Group on 10th September 2019.

4. Further work on additional needs component weighting (RAR055 – Additional needs component – weighting adjustment follow up)

Resource Allocation Review

Testing the population data used in the formula

Summary and introduction

The Welsh Government is seeking to closely replicate the Scottish allocation formula to allocate 2020/21 growth monies. We are testing a number of different components of our formula, specifically to understand whether it is a reasonable approximation of the Scottish formula. The testing is conducted in the context of the materiality of the growth monies, compressed timelines and public information available around the Scottish formulae. Further, a Part 2 of the programme will then need to reconsider more fully health allocations for monies post 2020/21.

This paper considers whether "*differential demographic growth between health boards impacts the fair share allocation compared to the needs of current the populations."* This short paper summarises evidence the review has found and our recommendations. It is noted that this constitutes preliminary thinking for the 2020/21 formulae only.

Findings:

- As part of the allocation formula, there are a number of options for how to source population data, such as either using observed populations or forecasts. Currently the Welsh formula uses observed 2017 population statistics.
- For the 2020/21 growth monies it is recommended for consistency to other formulae (including the Scottish model), that 2020 population forecasts developed by the Welsh Government (and re-based in 2018 to reflect the observed population) are used to capture the population component.
- Using population forecasts can help to account for expected changes in population dynamics, such as future demographic growth and changes in the age structure of local authorities. In addition, re-basing the forecasts also helps to ensure the projections use the latest data available.
- Initial testing of the materiality of the adjustment suggests that the potential update is unlikely to materially impact overall health allocations, given the formula currently distributes only additional growth monies.

This paper seeks TAG's approval of this initial recommendation (subject to further testing to be undertaken in August 2019).

Questions for the TAG

1. Are there additional options which should also be considered?
2. Of the options outlined, which is most appropriate to underpin the formula?
3. Does the TAG agree with the recommended option to use the 2020 (re-based) population forecasts as part of the formula? Is it justifiable?
4. Does the TAG agree to use the same recommended option as the basis for each formula component, for consistency?

Background

The different population dynamics in local authorities is sensitive and highly politicised. It is therefore important that the most appropriate population measures are included in the allocation formula, given the level of scrutiny which this element will be subjected to.

The work to date on the allocation formula has used 2017 mid-year estimates from Office of National Statistics (ONS). These have been superseded by 2018 mid-year estimates as of July 2019. While this measure reflects the most recent and accurate estimates of population size

and demographics, it does not account for expected changes in population dynamics, such as future demographic growth and changes in the age structure of local authorities.

The formula may therefore benefit from instead applying population projections, which aim to reflect these dynamics.

Options

Based on the information available, four options for sourcing the population data have been considered (including the current approach):

1. **2017 data** – work to date used 2017 mid-year estimates from ONS. These are outdated as of July 2019;
2. **2018 data – latest mid-year estimates** – updated 2018 data from ONS;
3. **2020 forecasts** – 2020 population forecasts produced by the Welsh Government (produced in 2014); and
4. **2020 forecasts (re-based)** – the same 2020 population forecasts produced by the Welsh Government, but re-based in 2018 to reflect the observed populations.

The table below summarises a number of pros and cons of each option.

Measure	Description	Pros	Cons
1. 2017 data	2017 mid-year estimates from ONS	• Uses reputable nationally recognised data source • Uses actual observed population data	• Does not account for expected future population dynamics • Outdated as of July 2019 • The Townsend formula was challenged for not building in population projections
2. 2018 data	2018 mid-year estimates from ONS, published end of July 2019 on StatsWales	• Uses reputable nationally recognised data source • Most up to date actual observed population data from July 2019	• Does not account for expected future population dynamics • The Townsend formula was challenged for not building in population projections
3. 2020 forecasts	2020 population forecasts produced by the Welsh Government (produced in 2014)	• Credible forecasts used based on ONS methodology, which underpin c. £5bn other funds nationally • Accounts for expected changes in population dynamics • Can help to address some of the challenges levelled at the Townsend formula (which was critiqued for not building in population projections)	• Subject to forecast error – forecasts will not be consistent with data eventually observed • Forecasts were produced in 2014 – the earlier that forecasts are produced, the greater the forecast error. • Could generate some inconsistencies with other Welsh Government formulae e.g. the local government funding formula
4. 2020 forecasts (re-based)	The same 2020 population forecasts produced by the Welsh Government, but re-based in 2018 to reflect the observed populations	• Credible forecasts used based on ONS methodology, which underpin c. £5bn other funds nationally • Accounts for expected changes in population dynamics • Re-basing to 2018 data helps to reduce forecast error • The re-basing approach is consistent to the methodology used in the Scottish formula • Can help to address some of the challenges levelled at the Townsend formula (which was critiqued for not building in population projections)	• Subject to forecast error – forecasts will not be consistent with data eventually observed • Could generate some inconsistencies with other Welsh Government formulae e.g. the local government funding formula

Recommendation

Based on the evidence available, it is recommended that option 4 – 2020 (re-based) population forecasts – are used as part of the formula.

Using robust, nationally recognised and evidence-based population forecasts can help to account for expected changes in population dynamics, such as future demographic growth and changes in the age structure of local authorities. Re-basing the forecasts also helps to ensure the projections use the latest data available. In addition, the Townsend formula was challenged for not building in population projections; and the recommended approach would therefore help to address this.

There is a risk that the recommended approach may generate some inconsistencies with other Welsh Government formulas, for example the local government funding formula, which uses observed population data rather than population forecasts. However, the methodology underpinning this formula was developed for the 2001/02 settlement and it is expected that this formula will be reviewed in the near term.

TAG is asked to approve the recommended option.

Testing the potential impact

We have tested the potential impact on the potential allocations of applying the different sources of population data (see Annex A).

Across all measures, the impact of the potential adjustment is unlikely to materially change the allocations, particularly given the formula currently proposed is only used to allocate growth monies (rather than the total funding). This testing has focussed on the acute component of the formula, however similar results are expected for the other components.

As an indicative estimate the largest change in allocation for any LHB is c. 0.01% of the total allocation or up to 0.08% of growth monies for individual local authorities. The impact on the allocations is likely to be more significant if a larger share of total budget was driven by the formula.

Next steps

Next steps, which are expected to be completed in August 2019, include:

- Further testing to understand the impacts;
- Comparisons against other Welsh Government formulae to ensure consistency where possible;
- Finalisation of 2018 population data to support the analysis; and
- Implementation of the preferred methodology in the formula.

It should be noted that Part 2 of the programme will reconsider more fully health allocations for monies post 2020/21, including the overall approach and methodology around the inclusion of population information in the formula.

Annex A

While the update would allocate a greater share of funding to areas with higher population growth, the overall impact on individual local authorities and health boards is low.

Table 6: Change in allocation of growth monies using 2017 population estimates vs 2018 population estimates

Local authority	MYE 2017			MYE 2018			Change in share of growth
	Population	Age-sex weighting	Weighted population	Population	Age-sex weighting	Weighted population	
Isle of Anglesey	69,794	1.11	77,292	69,961	1.10	77,225	0.00%
Gwynedd	123,742	1.04	128,923	124,178	1.04	128,626	-0.01%
Conwy	116,863	1.16	135,655	117,181	1.16	135,723	0.00%
Denbighshire	95,159	1.07	101,580	95,330	1.07	101,616	0.00%
Flintshire	155,155	1.00	155,010	155,593	1.00	155,066	0.00%
Wrexham	135,571	0.98	132,634	136,126	0.98	132,907	0.01%
Powys	132,515	1.14	151,162	132,447	1.14	151,104	0.00%
Ceredigion	73,076	1.08	78,831	72,992	1.08	78,750	0.00%
Pembrokeshire	124,711	1.11	137,970	125,055	1.11	138,393	0.01%
Carmarthenshire	186,452	1.07	198,654	187,568	1.06	198,976	0.01%
Swansea	245,480	0.97	237,932	246,466	0.96	237,375	-0.02%
Neath Port Talbot	142,090	1.00	142,385	142,906	1.00	142,279	0.00%
Bridgend	144,288	0.99	142,683	144,876	0.99	142,767	0.00%
Vale of Glamorgan	130,690	1.01	131,828	132,165	1.00	132,595	0.02%
Cardiff	362,756	0.85	307,613	364,248	0.84	306,033	-0.05%
Rhondda Cynon Taf	239,127	0.96	229,261	240,131	0.95	229,317	0.00%
Merthyr Tydfil	59,953	0.95	57,255	60,183	0.95	57,176	0.00%
Caerphilly	180,795	0.96	173,819	181,019	0.96	173,697	0.00%
Blaenau Gwent	69,609	0.99	68,588	69,713	0.98	68,301	-0.01%
Torfaen	92,264	1.00	91,948	93,049	0.99	92,136	0.01%
Monmouthshire	93,590	1.10	103,040	94,142	1.10	103,546	0.02%
Newport	151,485	0.93	141,099	153,302	0.92	141,557	0.01%

Table 7: Change in allocation of growth monies using 2017 population estimates vs 2020 projections (2014-based)

Local authority	MYE 2017			2020 projections			Change in share of growth
	Population	Age-sex weighting	Weighted population	Population	Age-sex weighting	Weighted population	
Isle of Anglesey	69,794	1.11	77,292	70,169	1.10	76,954	-0.01%
Gwynedd	123,742	1.04	128,923	124,426	1.04	129,104	0.01%
Conwy	116,863	1.16	135,655	117,223	1.15	134,635	-0.03%
Denbighshire	95,159	1.07	101,580	95,931	1.06	101,672	0.00%
Flintshire	155,155	1.00	155,010	155,442	1.01	156,226	0.04%
Wrexham	135,571	0.98	132,634	140,358	0.96	135,276	0.08%
Powys	132,515	1.14	151,162	131,514	1.16	151,911	0.02%
Ceredigion	73,076	1.08	78,831	76,812	1.05	80,283	0.05%
Pembrokeshire	124,711	1.11	137,970	124,241	1.10	136,951	-0.03%
Carmarthenshire	186,452	1.07	198,654	186,752	1.06	198,264	-0.01%
Swansea	245,480	0.97	237,932	246,752	0.97	238,202	0.01%
Neath Port Talbot	142,090	1.00	142,385	141,688	1.01	142,486	0.00%
Bridgend	144,288	0.99	142,683	143,683	0.99	142,076	-0.02%
Vale of Glamorgan	130,690	1.01	131,828	128,565	1.01	130,231	-0.05%
Cardiff	362,756	0.85	307,613	373,717	0.83	311,570	0.13%
Rhondda Cynon Taf	239,127	0.96	229,261	239,431	0.95	226,947	-0.07%
Merthyr Tydfil	59,953	0.95	57,255	59,287	0.95	56,497	-0.02%
Caerphilly	180,795	0.96	173,819	181,558	0.96	174,126	0.01%
Blaenau Gwent	69,609	0.99	68,588	69,314	0.98	67,909	-0.02%
Torfaen	92,264	1.00	91,948	92,182	0.99	91,555	-0.01%
Monmouthshire	93,590	1.10	103,040	93,209	1.11	103,560	0.02%
Newport	151,485	0.93	141,099	149,770	0.93	138,729	-0.08%

Table 8: Change in allocation of growth monies using 2017 population estimates vs 2020 projections re-based using 2018 estimates

Local authority	MYE 2017			2020 projections (re-based)			Change in share of growth
	Population	Age-sex weighting	Weighted population	Population	Age-sex weighting	Weighted population	
Isle of Anglesey	69,794	1.11	77,292	69,955	1.10	77,056	-0.01%
Gwynedd	123,742	1.04	128,923	124,944	1.03	128,300	-0.02%
Conwy	116,863	1.16	135,655	117,525	1.15	135,449	-0.01%
Denbighshire	95,159	1.07	101,580	95,730	1.06	101,492	0.00%
Flintshire	155,155	1.00	155,010	156,111	1.00	155,721	0.02%
Wrexham	135,571	0.98	132,634	137,341	0.97	133,299	0.02%
Powys	132,515	1.14	151,162	132,039	1.15	151,229	0.00%
Ceredigion	73,076	1.08	78,831	73,480	1.07	78,808	0.00%
Pembrokeshire	124,711	1.11	137,970	125,243	1.11	138,438	0.01%
Carmarthenshire	186,452	1.07	198,654	188,210	1.06	198,836	0.01%
Swansea	245,480	0.97	237,932	248,350	0.95	236,999	-0.03%
Neath Port Talbot	142,090	1.00	142,385	143,310	0.99	141,939	-0.01%
Bridgend	144,288	0.99	142,683	145,697	0.98	143,013	0.01%
Vale of Glamorgan	130,690	1.01	131,828	132,450	1.00	132,552	0.02%
Cardiff	362,756	0.85	307,613	371,006	0.83	307,647	0.00%
Rhondda Cynon Taf	239,127	0.96	229,261	241,080	0.95	228,293	-0.03%
Merthyr Tydfil	59,953	0.95	57,255	60,251	0.95	56,995	-0.01%
Caerphilly	180,795	0.96	173,819	181,551	0.96	173,757	0.00%
Blaenau Gwent	69,609	0.99	68,588	69,593	0.98	67,912	-0.02%
Torfaen	92,264	1.00	91,948	93,240	0.99	91,992	0.00%
Monmouthshire	93,590	1.10	103,040	94,420	1.10	104,231	0.04%
Newport	151,485	0.93	141,099	154,343	0.91	141,207	0.00%

Resource Allocation Review

Testing additional needs indicators

Summary and introduction

The Welsh Government is seeking to closely replicate the Scottish allocation formula to allocate 2020/21 growth monies. We are testing a number of different components of the formula, to understand whether it is a reasonable approximation of the Scottish formula. The testing is conducted in the context of the materiality of the growth monies, compressed timelines and public information available around the Scottish formulae. Further, a Part 2 of the programme will then reconsider more fully health allocations for monies post 2020/21.

This paper considers whether "*the weights of the additional needs indicators included in the formula are appropriate."* This short paper summarises evidence the review has found and our recommendations. It is noted that this constitutes preliminary thinking for the 2020/21 formulae only.

TAG paper RAR029 introduced a number of additional needs measures that could be included in the acute component of the formula. This paper builds on paper RAR029 and tests the indicators of additional need in the allocation formula.

This paper relates to the indices used in the acute component of the formula, but the analysis should equally apply to the other components.

Findings:

- Two additional needs indicators have been currently proposed: Age Standardised Mortality Rate (ASMR)[22]; and Limiting Long Term Illness (LLI).[23] These have been identified based on reviewing the Scottish formula.
- Two main lines of enquiry are explored:

5. **Weight of individual index values**. The two indices (ASMR and LLI) have the same weight (i.e. a simple average is taken of the two index values for each Local Authority), when combined to generate an overall composite index. We have explored the properties of the individual indices and tested a number of different weights. The indices are highly correlated, which suggests that different weights are unlikely to have a material impact. It is therefore difficult to justify an alternative weighting to the current assumption of a simple average.
6. **Weight of the overall composite index**. The resulting composite index is combined directly with the other components of the formula, without any weighting adjustment. Precedent and simple econometric analysis justifies an alternative weighting when feeding in to the overall formula. However, further work is needed in order to develop specific weightings which may be appropriate.

The TAG is asked to approve the recommendation for area #1; and note the ongoing work and testing on area #2. A further paper will be presented to TAG at the August meeting.

Questions for the TAG

1. Are the current additional needs indicator weights justifiable?
2. Does the analysis presented justify revising the additional needs indicator weightings?

[22] Death rate adjusted for the distribution of the population in each area (those aged under 75 only), sourced from ONS.
[23] The proportion of people in each area reporting they have a LLTI, sourced from Welsh Index of Multiple Deprivation based on 2011 census outputs from ONS.

3. Are there other options which could be considered to weight the additional needs indicators?
4. What further testing would be helpful?

Background and current proposal

Paper RAR029 discussed a number of additional measures of need that could be included in the acute component of the formula, including:

- Identifying additional measures of need, including setting out their sources and pros/cons;
- A description of the method used in the Scottish model; and
- Areas where the proposed Welsh approach differs from Scotland.

Based on the Scottish model, analysis of Welsh data and a TAG discussion, two indicators of additional need were identified and recommended for inclusion in the Welsh model:

1. Age Standardised Mortality Rate (ASMR)[24]; and
2. Long Term Limiting Illness (LLI).[25]

Two main assumptions are made when inputting the indices in to the formula:

1. **Weight of individual index values**. The two indices (ASMR and LLI) have the same weight (i.e. a simple average is taken of the two index values for each Local Authority), when combined to generate an overall composite index.
2. **Weight of the overall composite index**. The resulting composite index is combined directly with the other components of the formula, without any weighting adjustment.

These two main assumptions have been the main subject of testing.

Weight of individual index values

The current proposals for an equal weight across ASMR and LLI factors could still lead to implicit weights:

- If one index has a higher average value than another – for example if the average ASMR value was 2 and LLI was 1, then ASMR would by default be twice as important; and
- If one index has greater variation than another, this could skew the relative importance of indices for individual Local Authorities.

To explore this potential, the table below summarises a number of descriptive statistics of the Welsh indices by Local Authority. We note that there are only 22 observations, as such these statistics should be treated with caution.

[24] Death rate adjusted for the distribution of the population in each area (those aged under 75 only), sourced from ONS.
[25] The proportion of people in each area reporting they have a LLTI, sourced from Welsh Index of Multiple Deprivation based on 2011 census outputs from ONS.

Summary descriptive statistics

	Long term limiting illness (census)	ASMR (<75)
Mean	1.00	1.00
Variance	0.02	0.01
Observations	22	22
Df	21	21
F	1.29	
P(F<=f) one-tail	0.28	
F Critical one-tail	2.08	
Correlation coefficient		0.91

This table shows that:

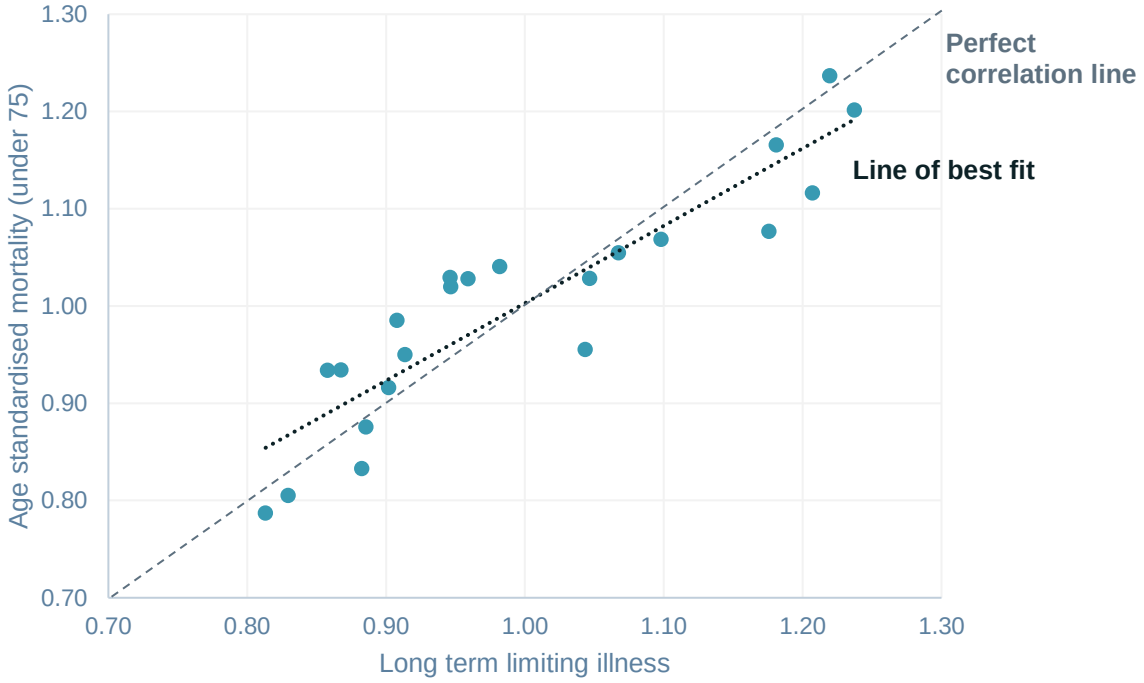
- The mean of the two indices is 1, by construction – suggesting that on average, the two individual indices, if weighted equally, have a similar level of importance.
- The P(F<=f) one-tail (0.28), suggests that the indicators have a similar variance level (a value lower than 0.05 for this indicator could suggest statistically that the indices behave differently). This means that when the indices are combined, they are on a comparable scale. This reduces the need to use z scores to standardise the two indices (as is used in the Scotland index).[26]
- The ASMR and LLI indices for Wales are highly correlated with each other.[27] This implies that the two indices are similar for many Local Authorities.

Given the high correlation and similarity of statistical properties, this could suggest that alternative weightings of the individual indices are unlikely to drive large differences in the overall 2020/21 allocations of growth monies.

The correlation is further illustrated in the figure below.

[26] Scotland use the sum of z scores in the construction of the additional needs index. Z scores are used to standardise data from different distributions so that they have a comparable mean of 0 and standard deviation of 1. This allows for comparison in terms of the position within the distribution and prevents the result being driven by the scaling across indicators. Testing the sum of z scores against the average needs index has a minimal impact on the final weighted index for Wales given that the mean and standard deviation/variance of the indices are already very similar.

[27] The correlation coefficient is 0.91 in Wales. It is noted that the correlation is much lower in Scotland (0.56).



Options for combining the additional needs indicators

There are a number of options to consider how the additional needs indicators could feed into the formula for 2020/21:

1. **Current model** – continue to weight the individual indices 50:50;
2. **Use ASMR only** – use only ASMR in the formula;
3. **Use LLI only** – use only LLI in the formula; and
4. **Alternative weighting** – apply an alternative weighting to the 50:50 weights used currently.

A number of pros and cons are included in the table below.

Measure	Description	Pros	Cons
1. Current model	Continue to weight the individual indices 50:50	• Simple and transparent • Rationale for a morbidity and mortality component • Limited evidence for an unequal weighting • Some consistency to Scottish approach[28]	• No strong evidence underpinning the weighting explicitly
2. Use ASMR only	Use only ASMR in the formula	• Applying one indicator is supported by a level of data analysis rather than default weightings • Likely to result in similar funding allocations to the current ratio	• From a narrative perspective, there is a justification for both a morbidity and mortality component • Using only one indicator is likely to be subject to challenge
3. Use LLI only	Use only LLI in the formula	• Applying one indicator is supported by a level of data analysis rather than default weightings • Likely to result in similar funding allocations to the current ratio	• From a narrative perspective, there is a justification for both a morbidity and mortality component • Using only one indicator is likely to be subject to challenge
4. Alternative weighting	Apply an alternative weighting to the 50:50 weights used currently.	• Rationale for including both indicators • Likely to result in similar funding allocations to the current ratio	• Limited evidence for the shares of a revised ratio

Recommendation for combining the additional needs indicators

Based on the evidence available, it is recommended that option 1 (current model) – continue to weight the individual indices 50:50 – is used as part of the formula.

There is a rationale for a morbidity and mortality component to be used as part of the formula (see paper RAR029) and limited evidence to suggest an alternative weighting to the 50:50 weighting. In additional, simple statistical testing suggests that alternative weights are unlikely to impact the funding growth shares, given the indicators are highly correlated.

TAG is asked to approve the recommended option for combining the additional needs indicators.

Testing the combination of additional needs indicators

We have tested the potential impact on the growth allocations of applying a number of different weights for the individual indices (see Annex B).

[28] Scotland use the sum of equally weighted z scores to derive the index. Given the similarity in the mean and variance of the individual indices in Wales, an equal weighting of z scores implies a close to equal weighting of the indices. http://www.nrac.scot.nhs.uk/docs/consultation/Technical%20Report%20D%20-%20Review%20of%20MLC.pdf

The impact of the potential adjustment is unlikely to materially change the allocations, particularly given the formula currently proposed is only used to allocate growth monies (rather than the total funding) in the context of allocating growth monies.

As an illustrative example, if, instead of a 50:50 weight, the weights were 90:10 for ASMR and LLI, the largest change in share for any LHB would be c. 0.3% of the growth monies. For example, a funding share of 5% could increase to 5.3%. The result is similar if a ratio of 10:90 is applied for ASMR and LLI. However, the impact on the allocations is likely to be more significant if a larger share of total budget was driven by the formula.

Weight of the overall composite index

In the current version of the Welsh model, the composite index (resulting from combining the ASMR and LLI indices) is combined directly with the other components of the formula, without any weighting adjustment. This implies that there is a one to one relationship between the additional needs index and the other components of the formula.

This is a different approach to the Scottish model, where the index is weighted implicitly as part of its overall econometric analysis. The econometric analysis in Scotland found a one unit increase in the needs index is related to between 0.03 and 0.15 increase in the cost ratio (see the table below). This is used to weight the needs index as it feeds into the model.

Model	Needs index (z score) coefficient
Cancer	0.045
Heart	0.094
Digestive	0.101
Injury	0.097
Other	0.084
Respiratory	0.154
Outpatients	0.035

Source: TAGRA-Acute-MLC-subgroup-14th-meeting-5-May-2016-Paper-TAMLC51-Analysis-of-new-model (1)

This could suggest that a 1:1 weighting could generate a formula which implies additional needs have a larger impact on costs than the overall population size and structure. Based on the Scottish result this is unlikely to be the case.

Further testing the weight of the overall composite index

In order to further investigate this, a simple model has been developed which tests the potential weighting of the composite index relative to the age / sex and cost component:

- Uses expenditure data for Welsh Health Boards for years 2013 to 2017 (from StatsWales) – to proxy need;
- Adjusts this data to account for the age / sex and cost weightings from the Health Foundation analysis of Welsh hospital cost curve – this generates a proxy for the needs and age / sex cost component; and
- Regresses the resulting adjusted expenditure on the additional needs indicators used in the Welsh model.

The coefficients could be used to provide an indication of the relative weights between the additional needs indicators and the needs with age / sex and cost.

As noted above, the indicators capturing ASMR and LLI for Wales are highly correlated with each other. This means that regression analysis which includes both indicators is likely to produce estimators with high standard errors. However, it is unlikely to reduce the predictive power or reliability of the analysis as a whole. As a result, both indicators are included in the analysis.[29]

It should be noted that the purpose of this analysis is a simple test, undertaken in a short period of time, to understand potential materiality. It does not reflect robust statistical modelling.

Initial results from simplified testing

The regression analysis suggests that a one unit increase in the ASMR and LLI indices together are related to between c. 0.1 and 0.7 increase in the age / sex cost ratio, with a midpoint of c. 0.4. The analysis was replicated using the sum of z scores for comparability of the coefficients to the Scottish model. An initial comparison suggests the weighting is slightly lower than Scotland but of a similar magnitude.[30] This suggests that a 1:1 weighting could give too much importance to the additional needs index, and a weighting of 5:2 (the age / sex and cost component being two and a half times as important as the additional needs) could be closer to initial regression analysis conducted here and in Scotland.

A full explanation of the methodology and output are included in Annex A.

It is noted that this analysis is indicative at this stage and would require significant refinement in the future.

Options for the weight of the overall composite index

There are a number of options around how the additional needs indicators feed into the formula for 2020/21:

1. **Current model** – continue to apply a 1:1 relationship between the additional needs index and the other components of the formula; and
2. **Revised weightings** – update the weighting from 1:1 to 5:2, so that the age / sex and cost component is two and a half times as important as the additional needs.

A number of pros and cons are included in the table below.

[29] For the tests of model specification which require consideration of changes over time, ASMR is taken alone as LLI is sourced from census data and does not change between years. For this form of the model, the coefficient on ASMR is taken to capture the coefficient on the overall index which is confirmed by the consistency of coefficients across each version of the model.
[30] A like for like comparison with the Scottish published coefficients is not possible as different levels of aggregation in terms of geography and diagnostic cohort are used. The coefficient for Scotland varies from 0.03 – 0.2 compared to a confidence interval range of 0.01 to 0.04 for Wales.

Measure	Description	Pros	Cons
1. Current model	Continue to apply a 1:1 relationship between the additional needs index and the other components of the formula	• Simple and transparent calculations	• Weightings and approach are inconsistent with the Scottish approach • 1:1 weighting overall index is unlikely to reflect reality
2. Revised weightings	Update the weighting from 1:1 to 5:2, so that the age / sex and cost component is twice as important as the additional needs.	• Likely to reflect a more appropriate weighting, more in line with other countries • Weightings more closely aligned to the Scottish approach • Weightings supported by a level of data analysis rather than default weightings	• Testing is based on very simplified analysis at this stage, using limited data • Approach adds more complexity and is less transparent • Additional rationale will be needed to justify the revised weightings

Testing the potential impact of revised weightings

We have tested the potential impact on the allocations of applying the revised weightings (see Annex C).

The impact of the potential adjustment is unlikely to materially change the allocations, particularly given the formula currently proposed is only used to allocate growth monies (rather than the total funding) in the context of allocating growth monies.

As an indicative estimate the largest change in allocation for any LHB is c. 1.3% of the growth monies or c. 0.2% of the board's total allocation. However, the impact of the weighting revision is significant and the impact on the allocations is likely to be more significant if a larger share of total budget was driven by the formula.

Recommendation for the weight of the overall composite index

The TAG is asked to note the ongoing work and testing. In particular, the TAG is asked for its views on the options and analysis to date.

Next steps

Next steps include the development of a further paper to be presented to TAG at the August meeting on area #2, including further testing of the potential impact and a recommended option.

It should be noted that Part 2 of the programme will reconsider more fully health allocations for monies post 2020/21, including the overall approach and methodology around the inclusion of additional needs indicators more generally.

Annex A: Technical output

A simple econometric approach was developed to test the relative importance of the indicators of additional need on overall relative need between health boards.

The ratio of expenditure to age-sex weighted share of costs for each health board was used to proxy relative need. This is the closest proxy available to capture the need of a population above that which can be explained by population demographics.

Spend over a five year period for each health board was used to strengthen the statistical power of the estimates, however the sample size remains small and care should be taken in applying the results.

As noted previously, ASMR under 75 and LLI are highly correlated. This means that this type of analysis is not suitable to derive a weighting between them. As LLI does not vary over time and the model considers multiple years of data to derive a weighting, the ASMR index alone has been included in the main model. The coefficient on ASMR is taken as representative of the overall weighting of the needs index to age-sex weighted cost index. As a sensitivity we have run the alternative versions of the model including (i) both the ASMR and LLI indices; and (ii) the needs index calculated as the average of the ASMR and LLI indices.

The simplified model does not include any supply-side factors due to time constraints and data limitations. Supply-side factors that could be considered include accessibility of services based on travel times or number of hospitals and clinics locally. Given these factors reflect the characteristics of each local health board and change little over time, a fixed effects model which controls for differences between health board characteristics which are not directly captured by the model was tested in the model specification.

Model specification

The fixed effects model was tested against a random effects model which allows for the effect of factors which vary between health boards, but which do not change over time. As most of the variation in the cost ratio and the needs indices is between health boards with limited variation over time a random effects specification is preferred as long as this does not lead to biased estimates. The Hausman test was used to tests the null hypothesis that there are not systematic difference between the random effects and fixed effects estimators in which case random effects is the preferred model. The null hypothesis is not rejected so random effects is taken as the preferred model.

Results

The implied weighting on the needs index for Wales is between c. 0.11 and 0.65 with a midpoint of c.0.38 and is statistically significant at the 1% level. This has been validated against the implied weightings in Scotland and are lower but within the same range.[31] The range of the implied weighting is large however all values in the range suggest the strength of the needs index on overall relative need of a health board is less than a one to one relationship. Taking the highest value, a 10% increase in the needs index relative to the national average would imply at most a 6.5% increase in cost compared to national average age-sex weighted costs.

[31] Like for like comparison is not possible as Scotland uses separate models by diagnostic group and the needs index is included as z scores. Additional analysis has been completed using z scores for Wales to aid comparison and top-down estimation of the Scottish weighting has been estimated as between c. 0.47 – 0.65 overall.

Table 9: Regression outputs for the relationship between relative need and ASMR index (random effects model)

RandomEffects Estimation Summary

Dep. Variable:	Relative_need	R-squared:	0.2019
Estimator:	RandomEffects	R-squared (Between):	0.6298
No. Observations:	35	R-squared (Within):	-0.0387
Date:	Thu, Jul 18 2019	R-squared (Overall):	0.5809
Time:	14:12:14	Log-likelihood	95.244
Cov. Estimator:	Unadjusted		
		F-statistic:	8.3462
Entities:	7	P-value	0.0068
Avg Obs:	5.0000	Distribution:	F(1,33)
Min Obs:	5.0000		
Max Obs:	5.0000	F-statistic (robust):	8.3462
		P-value	0.0068
Time periods:	5	Distribution:	F(1,33)
Avg Obs:	7.0000		
Min Obs:	7.0000		
Max Obs:	7.0000		

Parameter Estimates

	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
const	0.6223	0.1326	4.6951	0.0000	0.3527	0.8920
ASMR index	0.3832	0.1326	2.8890	0.0068	0.1133	0.6530

Table 10:Regression outputs for the relationship between relative need, and ASMR index and LLI index (random effects model)

RandomEffects Estimation Summary

Dep. Variable:	Relative_need	R-squared:	0.2938
Estimator:	RandomEffects	R-squared (Between):	0.7479
No. Observations:	35	R-squared (Within):	0.0098
Date:	Thu, Jul 18 2019	R-squared (Overall):	0.6939
Time:	14:12:55	Log-likelihood	96.690
Cov. Estimator:	Unadjusted		
		F-statistic:	6.6551
Entities:	7	P-value	0.0038
Avg Obs:	5.0000	Distribution:	F(2,32)
Min Obs:	5.0000		
Max Obs:	5.0000	F-statistic (robust):	6.6551
		P-value	0.0038
Time periods:	5	Distribution:	F(2,32)
Avg Obs:	7.0000		
Min Obs:	7.0000		
Max Obs:	7.0000		

Sum of coefficients is 0.39

Parameter Estimates

	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
const	0.6179	0.1246	4.9592	0.0000	0.3641	0.8717
ASMR index	0.0867	0.2073	0.4184	0.6785	-0.3356	0.5090
LLI index	0.3003	0.1628	1.8451	0.0743	-0.0312	0.6319

Table 11: Regression outputs for the relationship between relative need and average needs index (random effects model)

RandomEffects Estimation Summary

Dep. Variable:	Relative_need	R-squared:	0.3027
Estimator:	RandomEffects	R-squared (Between):	0.7340
No. Observations:	35	R-squared (Within):	0.0052
Date:	Thu, Jul 18 2019	R-squared (Overall):	0.6806
Time:	14:12:39	Log-likelihood	96.232
Cov. Estimator:	Unadjusted		
		F-statistic:	14.328
Entities:	7	P-value	0.0006
Avg Obs:	5.0000	Distribution:	F(1,33)
Min Obs:	5.0000		
Max Obs:	5.0000	F-statistic (robust):	14.328
		P-value	0.0006
Time periods:	5	Distribution:	F(1,33)
Avg Obs:	7.0000		
Min Obs:	7.0000		
Max Obs:	7.0000		

Parameter Estimates

	Parameter	Std. Err.	T-Stat	P-value	Lower CI	Upper CI
const	0.5886	0.1102	5.3418	0.0000	0.3644	0.8128
needs index	0.4167	0.1101	3.7852	0.0006	0.1927	0.6406

This analysis was repeated using the sum of z scores to replicate the Scottish approach and for comparison to the published needs index coefficients for models of specific diagnostic groups in Scotland.

Table 12:Regression outputs for the relationship between relative need and sum of z scores

RandomEffects Estimation Summary

Dep. Variable:	Relative_need	R-squared:	0.2884
Estimator:	RandomEffects	R-squared (Between):	0.7295
No. Observations:	35	R-squared (Within):	-0.0149
Date:	Thu, Jul 18 2019	R-squared (Overall):	0.6750
Time:	15:50:22	Log-likelihood	95.902
Cov. Estimator:	Unadjusted		
		F-statistic:	13.373
Entities:	7	P-value	0.0009
Avg Obs:	5.0000	Distribution:	F(1,33)
Min Obs:	5.0000		
Max Obs:	5.0000	F-statistic (robust):	13.373
		P-value	0.0009
Time periods:	5	Distribution:	F(1,33)
Avg Obs:	7.0000		
Min Obs:	7.0000		
Max Obs:	7.0000		

Parameter Estimates

	Parameter	Std. Err.	T-Stat	P-value	Lower CI	Upper CI
const	1.0054	0.0117	86.035	0.0000	0.9816	1.0291
sum_zscores	0.0229	0.0063	3.6569	0.0009	0.0102	0.0356

Annex B: Testing the weight of individual indices

The impact on the share of growth allocated to each Local Authority is presented for the extreme weightings of 100% LLI and 100% ASMR as this demonstrates the largest impact of any weighting for the average index.

Local Authority	Share of growth	Change in share of growth (from average index)		
	With LLI / ASMR average index	With LLI only	With ASMR only	With sum of z scores index
Isle of Anglesey	2.4%	-0.02%	0.02%	0.01%
Gwynedd	4.0%	-0.06%	0.06%	0.04%
Conwy	4.3%	-0.06%	0.06%	0.02%
Denbighshire	3.2%	-0.04%	0.04%	0.00%
Flintshire	4.8%	-0.06%	0.06%	0.04%
Wrexham	4.2%	-0.07%	0.07%	0.01%
Ceredigion	2.4%	0.02%	-0.02%	0.03%
Pembrokeshire	4.3%	-0.01%	0.01%	0.03%
Carmarthenshire	6.4%	0.11%	-0.11%	-0.01%
Swansea	7.7%	0.03%	-0.03%	-0.03%
Neath Port Talbot	4.8%	0.08%	-0.08%	-0.06%
Bridgend	4.7%	0.03%	-0.03%	-0.03%
Vale of Glamorgan	4.0%	0.01%	-0.01%	0.04%
Cardiff	9.8%	-0.14%	0.14%	0.02%
Rhondda Cynon Taf	7.8%	0.02%	-0.02%	-0.11%
Caerphilly	5.8%	0.11%	-0.11%	-0.06%
Blaenau Gwent	2.4%	-0.01%	0.01%	-0.04%
Torfaen	3.0%	0.01%	-0.01%	-0.02%
Monmouthshire	3.0%	0.02%	-0.02%	0.05%
Newport	4.5%	-0.05%	0.05%	0.00%
Powys	4.5%	0.02%	-0.02%	0.07%
Merthyr Tydfil	2.0%	0.01%	-0.01%	-0.03%

Annex C: Testing the potential impact (composite index)

Local Authority	Share of growth			Change in growth share from a 1:1 to 2:5:1 relationship
	1. before additional needs	2. with additional needs relationship 2.5:1	3. with additional needs relationship 1:1	
Isle of Anglesey	2.5%	2.4%	2.3%	-0.1%
Gwynedd	4.1%	4.0%	3.7%	-0.3%
Conwy	4.3%	4.2%	4.1%	-0.1%
Denbighshire	3.3%	3.2%	3.2%	0.0%
Flintshire	5.0%	4.8%	4.5%	-0.3%
Wrexham	4.2%	4.2%	4.2%	0.0%
Powys	4.8%	4.5%	3.9%	-0.5%
Ceredigion	2.5%	2.4%	2.2%	-0.2%
Pembrokeshire	4.4%	4.3%	4.0%	-0.3%
Carmarthenshire	6.4%	6.4%	6.3%	0.0%
Swansea	7.6%	7.7%	7.9%	0.2%
Neath Port Talbot	4.6%	4.8%	5.3%	0.4%
Bridgend	4.6%	4.7%	4.9%	0.2%
Vale of Glamorgan	4.2%	4.0%	3.7%	-0.3%
Cardiff	9.8%	9.8%	9.7%	-0.1%
Rhondda Cynon Taf	7.3%	7.8%	8.6%	0.8%
Merthyr Tydfil	1.8%	2.0%	2.2%	0.2%
Caerphilly	5.6%	5.8%	6.3%	0.4%
Blaenau Gwent	2.2%	2.4%	2.7%	0.3%
Torfaen	2.9%	3.0%	3.1%	0.1%
Monmouthshire	3.3%	3.0%	2.6%	-0.4%
Newport	4.5%	4.5%	4.6%	0.0%

Resource Allocation Review

Testing differential costs across community services

Summary and introduction

The Welsh Government is seeking to closely replicate the Scottish allocation formula to allocate 2020/21 growth monies. We are testing a number of different components of our formula, specifically to understand whether it is a reasonable approximation of the Scottish formula. The testing is conducted in the context of the materiality of the growth monies, compressed timelines and public information available around the Scottish formulae. Further, a Part 2 of the programme will then need to reconsider more fully health allocations for monies post 2020/21.

This paper considers whether "*The costs of delivering community services are higher in rural settings and this should be reflected in the formula."* This short paper summarises evidence the review has found and our recommendations. It is noted that this constitutes preliminary thinking for the 2020/21 formulae only.

Findings:

- Many allocation formulae include adjustments to account for additional travel costs associated with serving more dispersed and rural population. However, the evidence is limited around whether these costs do exist and the actual scale of impact.
- For the 2020/21 growth monies it is recommended for consistency to other formulae, that an adjustment for excess community costs is included. However, this should be reappraised in Part 2.
- There is limited information available to develop an adjustment. As such, it is recommended that the adjustment combines Welsh travel time information from WIMD with Scottish input assumptions around travel and workload.
- Initial testing of the materiality of the adjustment suggests that the potential update is unlikely to materially impact overall health allocations, given the formula currently distributes only additional growth monies.

This paper seeks TAG's approval of this initial recommendation (subject to further testing to be undertaken in August 2019).

Questions for the TAG

1. Should the formula for 2020/21 include a component to capture the differential costs of providing community services?
2. Is it feasible to implement this approach?
3. Is the approach justifiable?
4. Does TAG approve the recommended approach, subject to the further testing outlined?

Background

Many community services are travel-based with nurses and health visitors travelling to patients in their homes. In rural areas patients are more spread out over large geographic areas. This may lead to higher costs of providing rural community services if:

- Health professionals spend more time travelling so there is more unproductive time; and / or
- The cost of travelling between patients is higher due to larger distances covered or more expensive modes of transport.

However, it is challenging to quantify the relevance and importance of these factors given the limitations in available data.

Issues around rurality and community services costs adjustments are highly politicised and subject to significant scrutiny. It is therefore important to ensure that any adjustment (including a decision to not include an adjustment) is justified, and underpinned by a strong evidence base.

Precedent

A number of allocation formulae use travel based models to develop a community services excess costs component (see below).

Formulas	Travel based	Key features
1. **Townsend formula (adjusted)**[32]	✓	• Applied to 7.5% of expenditure
2. **Scotland**[33]	✓	• Staff location assumed from settlement size
3. **Northern Ireland**[34]	✓	• Accounts for mileage • Requires base locations • Allocates £49m rurality pot
4. **England (public health)**[35]	✓	• Optimises journeys
5. **England (community) - plan**[36]	✓	• Potential workload model based on new community data

- The Townsend formula included a travel based community services cost adjustment;
- The Scottish model uses a travel simulation model which assumes that professionals are based in settlements and must travel to patients' homes, and uses the Practice Team Information dataset for District Nurses and Health Visitors;
- Northern Ireland also uses information on community base locations and contact durations to model rural adjustments for community services based on travel times and workload assumptions; and
- England is considering a similar adjustment for future allocations and has developed proposals around health visitors in the past.

Despite this precedent and rationale, some initial conversations in the Welsh Government with nursing colleagues have suggested that there is no evidence of higher travel times and costs.

While there is limited direct evidence to inform an adjustment in the Welsh formula at this stage:

- A number of other formulae do apply an adjustment to capture the differential costs of delivering community services; and
- All other formulae reviewed to date apply similar approaches, based on travel time.

[32] *Townsend report Vol 2 recommendation for community travel adjustment:* https://www.bristol.ac.uk/poverty/downloads/healthinequalities/NHS-RAR.pdf
[33] Scotland technical advisory group on resource allocations review of rurality adjustment for community excess costs: https://www.tagra.scot.nhs.uk/subgroups/remote-and-rural/
[34] Northern Ireland review of rurality adjustment: http://www.hscboard.hscni.net/download/Consultations/2015-16-Proposed-changes-to-the-NI-weighted-capitation-formula/Capitation%20Report.pdf
[35] England adjustment for sparsity based on travel time for home visits in public health services for children under 5: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/468912/3_Public_health_proposed_formula_2016-17_Technical_Guide_-_amended.pdf
[36] England recommendation for new community services formula with plans for a community nursing cost adjustment: https://www.england.nhs.uk/wp-content/uploads/2019/01/04-pb-31-01-2019-ccg-allocations-board-paper.pdf

Inclusion of an adjustment to account for excess community costs, would therefore be consistent to formulae developed in other countries, which have tended to apply similar approaches.

Options for consideration

There are a number of options to be considered:

1. **Current model** – continue to assume no adjustment for excess community costs;
2. **Adjustment based on Welsh inputs** – develop an adjustment which uses Welsh data to drive the additional costs component; and
3. **Adjustment based on Welsh and Scottish inputs** – develop an adjustment which uses Welsh data where this is readily available e.g. around travel times, and inputs from the Scottish formula (e.g. around average time spent travelling for community services) to drive the additional costs component. Scottish data is readily available and appropriate given the overall approach to replicating a number of elements of the Scottish model for the 2020/21 growth allocations.

A number of pros and cons of the options are included in the table below.

Measure	Description	Pros	Cons
1. Current model	Continue to assume no adjustment for excess community costs	• Simple and transparent • Any adjustment is unlikely to materially impact the allocations	• There is likely to be significant challenge around a model which does not include an adjustment • Not including an adjustment is inconsistent with the Scottish formula – which the overall Welsh formula is currently based on as a starting point
2. Adjustment based on Welsh inputs	Develop an adjustment which uses Welsh data to drive the additional costs component	• Consistent to a range of precedent • Inputs would fully reflect the Welsh model of delivering community services	• Developing and agreeing the full set of input data needed around Welsh community services would be a significant undertaking • Developing this approach would not be possible within the timeline for the 2020/21 model
3. Adjustment based on Welsh and Scottish inputs	Develop an adjustment which uses inputs from the Scottish formula, and Welsh data where this is readily available, to drive the additional costs component	• Consistent to a range of precedent • Welsh travel times used which is the most important input • The inputs drawn from the Scottish model are unlikely to vary significantly in Wales • Approach could be implemented quickly to support the work on the 2020/21 formula	• Inputs from the Scottish model may not accurately reflect Welsh service models • The evidence base of the adjustment may be subject to challenge

Emerging recommended approach to account for excess community costs

The current model with no adjustment for excess community costs is likely to generate significant challenge. In addition, a model which fully draws on Welsh data and inputs to support the 2020/21 allocations is unlikely to be feasible.

An emerging recommended approach has therefore been put forward based on option 3 (adjustment based on Welsh and Scottish inputs). This involves combining Welsh travel time analysis from WIMD with Scottish input assumptions around travel and workload (which are publicly available), to develop the additional costs component. There are three steps:

1. **Estimate travel times**. Estimate the average travel times from specified central locations to all LSOAs for each local authority – for example using components within WIMD.

2. **Estimate non-travel time per contact.** For a range of community services, estimate the average (weighted by cost) contact duration and set up time for home visits (inputs from

Scottish model). Work is ongoing to assess these inputs against a number of example service models in Wales to test comparability.

3. **Develop a weighted travel time index**. Based on the travel time variation between local authorities estimated in (1) and average contact time before travel in (2), develop an index of variation in overall staff time per contact – with higher values for local authorities with more dispersed populations.

The weighted index can then be fed in to the community services formula. This can be further weighted by the community share of costs (c. 13.5%) to assess the impact on overall growth monies allocations. Annex A includes the set of inputs used in the Scottish model.

There are a number of advantages of this approach:

- **Precedent** – a number of other formulae apply similar adjustments, and all use a common methodology;
- **Scottish model consistency** – the approach to using Scottish input data is consistent to the overarching approach to using the Scottish formula as the basis for developing the Welsh formula to date; and
- **Public expectations** – there is often an expectation that the additional travel component in rural areas drives higher costs – incorporating this uplift in the formula would help to capture any impact.

Recommendation

Based on the evidence available, it is recommended that the community services excess costs adjustment (combining Welsh travel time analysis and Scottish input assumptions), is used as part of the formula. This is subject to further testing which we are undertaking in August 2019 as well as testing to be undertaken later in 2019 as part of the full review of the allocation formula.

While the availability of quantitative evidence to support an adjustment in Wales is limited, the approach is consistent to similar components which have been developed to underpin formulae in other countries. This includes the Scottish formula which has been used as the basis for developing the Welsh formula to date.

TAG is asked to approve the recommended option, subject to the further testing outlined.

Testing the potential impact

Test 1

We have undertaken initial testing of the potential impact on the allocations of applying an indicative uplift based on the Scottish workload model (see Annex B).

The impact of the potential adjustment is unlikely to materially change the overall allocations, particularly given:

- Community services is a relatively small part of the total allocation – and within this, the component only adjusts the services which are travel related; and
- More generally, the formula currently proposed is only used to allocate growth monies (rather than the total funding) in the context of allocating growth monies.

As an indicative estimate the largest change in allocation for any local authority is c. 0.04% of the growth monies or c. 0.0008% of total allocation. As an example the share of discretionary growth for a local authority with a cost weighted population share of 5% would increase to 5.04% under the maximum impact. The impact on the allocations is likely to be more significant if a larger share of total budget was driven by the formula.

Test 2

A further analysis has been undertaken using the Scottish formula to test the potential impact of introducing its community services excess costs component (see Annex B). This analysis suggests that upon introducing the addition costs component, individual Scottish health boards' shares changed by less than 0.1% of total allocation, with the exception of the Scottish Highlands which increased by c. 0.2% after the adjustment was introduced (see Annex C). Given the more extreme rurality of the Scottish Highlands compared to rural areas in Wales, it is expected that a similar adjustment in Wales based on a common methodology would likely have a smaller impact on funding allocations (compared to no adjustment).

Next steps

There are a number of immediate next steps to finalise the 2020/21 formula, which will be undertaken in August 2019, including:

- Testing comparability of the Scottish inputs (August 2019);
- Revising expenditure weights between community services to reflect Welsh costing returns (August 2019); and
- Further testing to understand the impacts (August 2019).

Following this, as part of the overall review and reform of the formula (Part 2 of the programme), there are likely to be a number of additional next steps (later in 2019):

- Consideration of bottom up travel time analysis;
- Detailed comparisons against community services excess cost components in other formulae; and
- Development of Welsh specific inputs around service mix and workload.

It should however, be noted that Part 2 of the programme will reconsider more fully health allocations for monies post 2020/21, including the overall approach and methodology around community services excess costs.

Annex A: Scottish model inputs

The Scottish model uses a travel simulation model which assumes that professionals are based in settlements and must travel to patients' homes, and uses the Practice Team Information dataset for District Nurses and Health Visitors.

The table below summarises the input assumptions used in the Scottish model.

Service	Expenditure weight (%)	Contact duration (min)	Setup time (min)	Home-visits (%)
Community Psychiatric Team	13.5	45	5	50
Physiotherapy	2.2	60	5	50
Occupational Therapy	1.3	60	5	50
District Nursing	15.2	29	5	91
Speech Therapy	1.8	29	5	25
Addiction Services	2.6	50	5	25
Chiropody	2.4	29	5	25
Health Visiting	7.7	29	5	48
Midwifery	2.9	29	5	25
Dietetics	0.7	29	5	35
Community Learning Disabilities Teams	2.7	29	5	70
Large Settlement Services	47.0	29	5	25

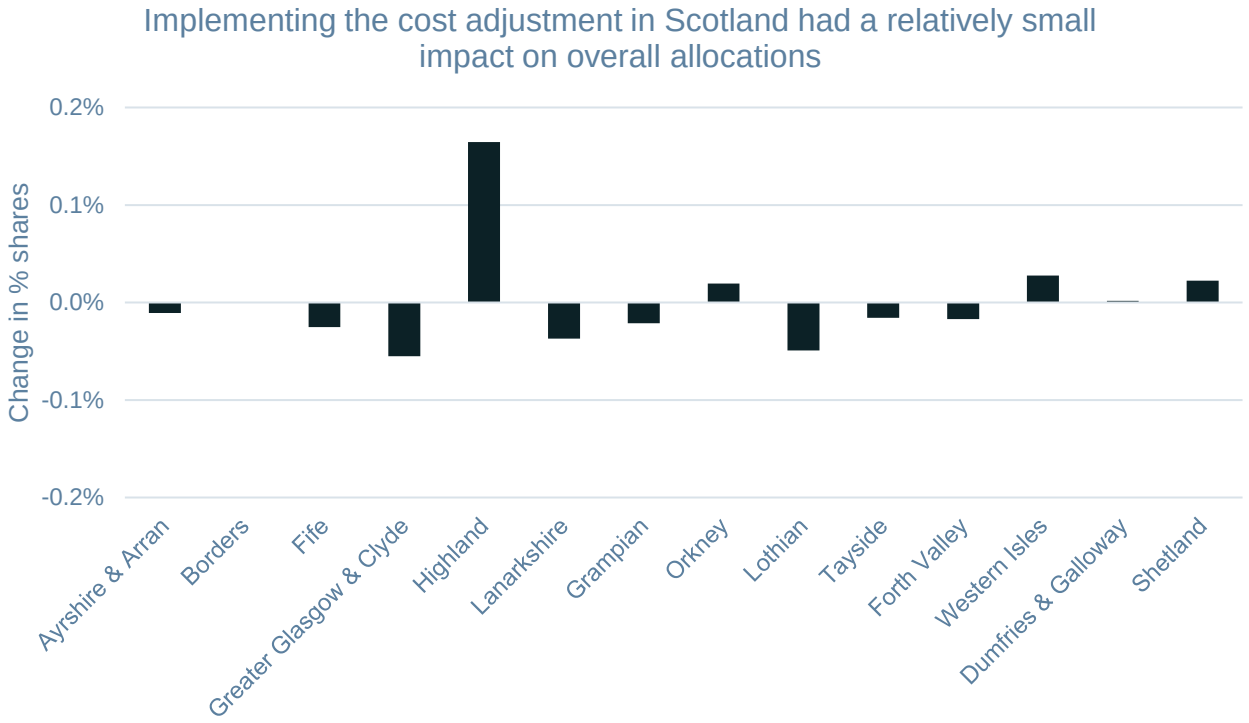
Source: TAGRA - remote and rural subgroup - 1st meeting - 5 May 2011 - Paper TRR04 - staff and travel costs

Annex B: Testing the potential impact

Local authority	WIMD travel time to GP (private)	Total time per contact (average)	Travel time variation	Weighted* travel time index	Share of growth			Change in share of overall growth
					Before community excess costs	With excess costs (community growth)	With excess costs (overall growth)	
Isle of Anglesey	6	50.15	1.00	1.00	2.5%	2.5%	2.5%	0.00%
Gwynedd	8	54.15	1.08	1.03	4.1%	4.3%	4.1%	0.02%
Conwy	6	50.15	1.00	1.00	4.3%	4.3%	4.3%	0.00%
Denbighshire	5	48.15	0.96	0.98	3.3%	3.2%	3.2%	-0.01%
Flintshire	6	50.15	1.00	1.00	5.0%	5.0%	5.0%	0.00%
Wrexham	4	46.15	0.92	0.97	4.2%	4.1%	4.2%	-0.02%
Powys	9	56.15	1.12	1.05	4.8%	5.1%	4.9%	0.03%
Ceredigion	12	62.15	1.24	1.10	2.5%	2.8%	2.6%	0.03%
Pembrokeshire	10	58.15	1.16	1.07	4.4%	4.7%	4.5%	0.04%
Carmarthenshire	7	52.15	1.04	1.02	6.4%	6.5%	6.4%	0.01%
Swansea	5	48.15	0.96	0.98	7.6%	7.5%	7.6%	-0.02%
Neath Port Talbot	5	48.15	0.96	0.98	4.6%	4.5%	4.5%	-0.01%
Bridgend	5	48.15	0.96	0.98	4.6%	4.5%	4.6%	-0.01%
Vale of Glamorgan	5	48.15	0.96	0.98	4.2%	4.1%	4.2%	-0.01%
Cardiff	3	44.15	0.88	0.95	9.8%	9.3%	9.8%	-0.07%
Rhondda Cynon Taf	4	46.15	0.92	0.97	7.3%	7.1%	7.3%	-0.03%
Merthyr Tydfil	5	48.15	0.96	0.98	1.8%	1.8%	1.8%	0.00%
Caerphilly	4	46.15	0.92	0.97	5.6%	5.4%	5.5%	-0.03%
Blaenau Gwent	4	46.15	0.92	0.97	2.2%	2.1%	2.2%	-0.01%
Torfaen	4	46.15	0.92	0.97	2.9%	2.8%	2.9%	-0.01%
Monmouthshire	6	50.15	1.00	1.00	3.3%	3.3%	3.3%	0.00%
Newport	4	46.15	0.92	0.97	4.5%	4.4%	4.5%	-0.02%

* *Weighted for percentage of home-visits compared to clinic-based activity.*

Annex C: Impact of the excess cost adjustment for travel-based community services on overall allocation shares in Scotland (2019/20).



Source: https://www.isdscotland.org/Health-Topics/Finance/Resource-Allocation-Formula/resource-allocation-latest.asp

Resource Allocation Review

Additional needs component – weighting adjustment follow up paper

Summary

The Welsh Government is developing an approach, closely aligned to the Scottish formula, to allocate growth funding in the discretionary HCHSP budget for 2020/21 (the "Growth Formula"). We are testing a number of components of the formula, to understand whether it is a reasonable approximation of the Scottish formula. The testing is conducted in the context of the materiality of the growth monies, compressed timelines and public information available around the Scottish formulae. Further, a Part 2 of the programme will then reconsider more fully health allocations for monies post 2020/21.

TAG paper RAR050 (discussed at TAG on 25 July 2019) tested the additional needs component. TAG agreed with the content and analysis included in the paper, and recommended that further work is undertaken to refine the analysis to allow a specific recommendation for the Growth Formula to be developed.

This paper builds on TAG paper RAR050, providing further analysis and discussion of the weighting on the additional needs component in the overall formula (illustrated in Figure 1). It is noted that this constitutes preliminary thinking for the Growth Formula only.

Figure 2: Overall approach to the Growth Formula and weighting on the four component parts

Findings:

- The current approach (presented in this paper as Option 1) includes a one to one weighting between additional needs and other factors such as population and age / sex. This implies that a 10% increase in additional needs has the same impact on relative healthcare need as a population increase of 10%. This suggests a strong emphasis on reducing health inequalities, as in the Townsend formula. However, a high weight on additional needs could discount other key determinants of need such as the number of people in a particular area.
- The TAG meeting on 25 July 2019 agreed more work should be done in order to consider a departure from a one to one weighting.
- We have set out in this paper a number of options for alternative weightings; from weighting of 1 in option 1 (a greater emphasis on additional needs), through to 0.4 in option 5 (a reduced emphasis on additional needs and a greater focus on capitation).
- Initial econometric analysis undertaken by the Welsh Government suggests that applying a lower weighting of c. 0.4 – 0.5 (aligned to option 4 and option 5 in this paper) on additional needs index may be appropriate. This weighting suggests that a 10% increase in additional needs indicators could relate to a 4% – 5% increase in resources required. This aligns more closely to the Scottish formula. These weights suggest a balance between reflecting the core drivers of need (population, age / sex) and reflecting additional needs drivers to help address health inequalities.

- An uplift on the weighting estimated by the econometric analysis (e.g. c. 0.6 aligned to option 3) could be considered in the Growth Formula to put a larger emphasis on addressing health inequalities. This could potentially be consistent to the approach in England where 10% of allocations are allocated based on ASMR under 75 in a top slice adjustment for health inequalities and unmet need, driven by policy objectives.
- Based on these findings, it is recommended that TAG considers a weighting between option 3, 4 and 5 (c. 0.4 – 0.6) for the Growth Formula in 2020/21.
- The econometric analysis to actually empirically estimate the weights is at an early stage of development. It will require significant further refinement in future work. This is not achievable in the timelines of this work.

The TAG is requested to develop a preference for the most appropriate option for inclusion in the Growth Formula.

Questions for the TAG

1. Are there other options which could be considered to weight the additional needs indicators?
2. Is TAG in a position to develop a recommended option?

Introduction

TAG paper RAR050 (discussed at TAG on 25 July 2019) tested the additional needs component as part of the approach to allocate growth funding in the discretionary HCHSP budget for 2020/21 (the “Growth Formula”). On 25 July 2019, TAG agreed with the content and analysis included in the paper, and recommended that further work is undertaken to refine the analysis to allow a specific recommendation for the Growth Formula to be developed.

This paper follows TAG paper RAR050 and provides further analysis and discussion.

Recap of RAR050

The Growth Formula uses the same combination of additional needs indicators as the Scottish Formula (LLTI and ASMR). However, the application of these indicators to form an additional needs index varies.

Two main lines of enquiry were explored in TAG paper RAR050:

#1 **Weight of individual index values**. The two indices (ASMR and LLTI) have the same weight (i.e. a simple average is taken of the two index values for each Local Authority), when combined to generate an overall composite index. The properties of the individual indices were explored, including the distribution of the indices and the relationship between them. A number of different weights were also tested. The indices are highly correlated, which suggests that different weights are unlikely to have a material impact. The TAG agreed that it is difficult to justify an alternative weighting to the current assumption of a simple average between ASMR and LLTI.

#2 **Weight of the overall composite index**. The resulting composite index is combined directly with the other components of the formula, without any weighting adjustment. This implies that there is a one to one relationship between the additional needs index and the other components of the formula as shown in Figure 3. This is a different approach to the Scottish model, where the index is weighted implicitly as part of its overall econometric analysis. The econometric analysis in Scotland found a one unit increase in the additional needs index (constructed as sum of z scores) is related to between 0.03 and 0.15 increase in the cost ratio. This is used to weight the needs index as it feeds into the model. This precedent as well as simple econometric analysis undertaken to support TAG paper RAR050 justifies an alternative weighting to one to one when feeding in to

the overall Growth Formula. However, TAG agreed that further work is needed in order to develop specific weightings which may be appropriate.

This TAG paper is a follow up to #2 above.

This paper explores the impact of alternative weightings (from 1 to 0.4) on the additional needs index in the overall formula in the context of policy priorities to reduce health inequalities. It also refines the statistical testing of the relationship between the indicators of additional needs indicators and costs following input from an academic econometrics professor.

Figure 3: Overall approach to the Growth Formula and weighting on the four component parts

Implications of the current approach

The current weighting between the composite LLTI and ASMR index and the other components of the formula implies that there is a one to one relationship between the additional needs index and the other components of the formula such as the population, see Figure 3. The share of population and age-sex cost index directly relate to each other in a one to one weighting as they are both derived from the population base. The weighting on the additional cost index (in the community formula only) is implicit in the index construction[37] and is not considered further in this paper as the impact on growth allocations would be small.

The current one to one weighting on the additional needs index implies that if ASMR and LLTI indices are 10% higher than average for a given Local Health Board (LHB), then the allocation of resources to that LHB is 10% higher. The one to one ratio implies that the impact is the same for a 10% change in another component of the formula, such as the overall population. For example, a 10% increase in the population of an LHB would also increase the allocation of resources to an LHB by 10%.

Scottish approach

The Scottish Resource Allocation Formula uses econometric analysis to construct the weighting of the additional needs index. This models the relationship between variation in the additional needs indicators and relative need as proxied by costs above those explained by the age, sex and size of the population. The Scottish needs index is constructed differently from the Welsh index, so the results are not directly comparable. However, we have estimated that if the Welsh additional needs index was used in the Scottish formula the implied relationship could be c. 0.53 – suggesting that a 10% increase in additional needs indicators could relate to a c. 5.3% increase in resources needed.

Testing the relationship with Welsh data

The initial econometric testing included in TAG paper RAR050 has been refined, retaining similar results (see appendix for details). This analysis suggests that the relationship between additional needs indicators and relative healthcare needs between boards in Wales could be around 0.4 – 0.5. This suggests that a 10% increase in additional needs indicators could relate to a 4% – 5% increase in resources needed. This result aligns closely to the estimate of the

[37] The community additional cost index weights travel times relative to assumptions on contact durations and the share of services that are travel-based. This approach aims to directly proxy relative additional cost per capita.

relationship in Scotland. It should however, be noted that this econometric analysis to actually empirically estimate the weights is at an early stage of development. It will require significant further refinement in future work. This is not achievable in the timelines of this work.

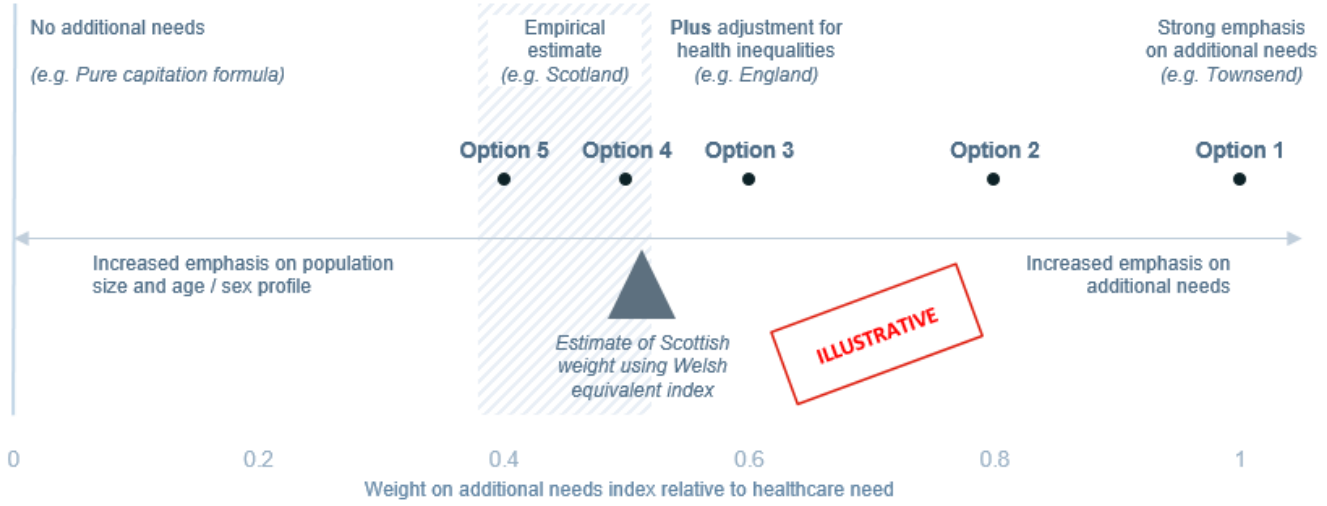
Policy implications

Different weights between the additional needs indicators and the other components in the model such as population, imply different preferences over the factors influencing allocations. For example, placing a stronger weight on additional needs could help to address health inequalities at a faster pace. However, a very high weight on additional needs could discount other key determinants of need.

Options

A number of options have been developed and are summarised in the figure below. The options describe a range of potential weights for the additional needs indices, from 1 in option 1 (a greater emphasis on additional needs), through to 0.4 in option 5 (a reduced emphasis on additional needs and a greater focus on capitation).

Given the lack of definitive evidence at this stage, the options comprise broad policy choices.



Option 1: Retain current unweighted additional needs index.

A 10% increase in additional needs has the same impact on relative healthcare need as a population increase of 10%. This is the current approach and implies a strong emphasis on reducing health inequalities, such as the Townsend formula. However, the very high weight on additional needs could discount other key determinants of need such as population.

Option 2: Apply a weighting of c. 0.8 to additional needs index

A 10% increase in additional needs has the same impact on relative healthcare need as a population increase of 8%. This option retains a strong emphasis on reducing health inequalities.

Option 3: Apply a weighting of c. 0.6 to additional needs index

A 10% increase in additional needs has the same impact on relative healthcare need as a population increase of 6%. This option reflects a slightly higher weight towards additional needs and addressing health inequalities compared to Scotland. A higher weighting, whilst retaining the core drivers of need is potentially consistent to the current approach in England. In particular, in England, the allocation formula develops an econometric model – with some similarities to Scotland but with added complexities – to distribute 90% of the funding, before allocating the remaining 10% based on the ASMR for < 75 to address health inequalities and

unmet need. This is in addition to reflecting a number of additional needs drivers, over and above age and sex, in the formula component.

Option 4: Apply a weighting of c. 0.5 to additional needs index

A 10% increase in additional needs has the same impact on relative healthcare need as a population increase of 5%. This weighting aligns to the initial econometric analysis undertaken on Welsh data (see annex) as well as the weights implied by the Scottish model. These weights suggest a balance between reflecting the core drivers of need (population, age / sex) and reflecting additional needs drivers to help address health inequalities.

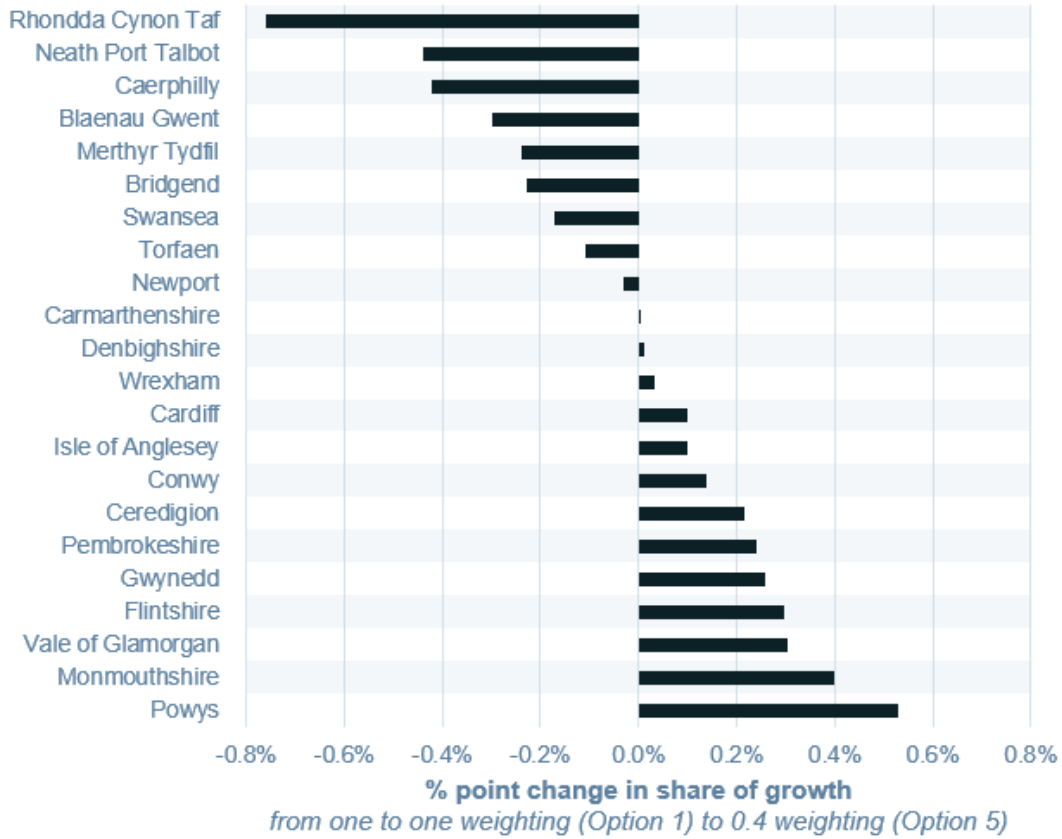
Option 5: Apply a weighting of c. 0.4 to additional needs index

A 10% increase in additional needs has the same impact on relative healthcare need as a population increase of 4%. This weighting aligns to the initial econometric analysis undertaken on Welsh data (see annex) as well as the weights implied by the Scottish model – albeit with a slightly lower emphasis on additional needs and a greater weighting towards capitation, compared to Option 4. These weights suggest a balance between reflecting the core drivers of need (population, age / sex) and reflecting additional needs drivers to help address health inequalities.

The impact of each option on the additional needs index and Local Authority shares of growth monies are shown in Tables 1 and 2 of Annex 1, respectively.

The impact of the additional needs weighting on growth allocations is material; the difference between the highest and lowest weights (option 1 and option 5) reflects a change of up to c. 0.8% of growth monies (based on 19/20 growth this could relate to c.£1m). Figure 4 shows the impact on Local Authority allocation shares of moving from option 1 (a greater emphasis on additional needs) to option 5 (a reduced emphasis on additional needs and a greater focus on capitation).

Figure 4: Maximum impact of weighting options on Local Authority share of growth money



Conclusion

The evidence and international examples considered demonstrate the trade-offs between options. The choice of weighting on additional needs could have a material impact on allocations when considering the full range of options from 1 to 5. However, the evidence to support options with a higher weight on additional needs – options 1 and 2, is more limited.

Options 4 and 5 provide a weighting which is consistent with a simplified empirical approach applied to Scottish and Welsh data. Option 3 builds on the empirical estimates with an additional uplift for additional needs, which could be justified using similar arguments as made in England for the health inequalities and unmet need adjustment (which allocates 10% of funding based on ASMR<75), driven by policy objectives. As a result, it is recommended that TAG considers a weighting between option 3, 4 and 5 for the Growth Formula.

Recommendation

The TAG is requested to:

- Consider the evidence which suggests a weighting between option 3, 4 and 5 and develop a preference within this range for use in the Growth Formula for 2020/21 to reflect policy objectives.

- Acknowledge further work on additional needs is required to develop the Growth Formula for use beyond 2020/21 allocations. This could include refining the relevant indicators for other Programmes of Care (as future work is likely to include ring fenced budgets currently outside of the discretionary formula), consideration of supply driven demand and the impact of multiple co-morbidities. The index weighting will need to be re-visited in this context.

Annex 1: additional needs index detail

Table 1: Comparison of the additional needs index under the five options by Local Authority

Local authority	Population share	Age-sex costs index	Age-sex weighted share	Additional needs index				
				Option 1	Option 2	Option 3	Option 4	Option 5
				A 10% increase in additional needs increases relative healthcare need by:				
				10%	*8%*	*6%*	*5%*	*4%*
Isle of Anglesey	2.2%	1.11	2.5%	0.93	0.95	0.96	0.97	0.97
Gwynedd	4.0%	1.04	4.1%	0.90	0.92	0.94	0.95	0.96
Conwy	3.7%	1.16	4.3%	0.95	0.96	0.97	0.97	0.98
Denbighshire	3.0%	1.07	3.2%	0.99	0.99	1.00	1.00	1.00
Flintshire	4.9%	1.01	5.0%	0.90	0.92	0.94	0.95	0.96
Wrexham	4.4%	0.98	4.3%	0.99	0.99	0.99	0.99	1.00
Powys	4.2%	1.16	4.8%	0.82	0.85	0.89	0.91	0.93
Ceredigion	2.3%	1.08	2.5%	0.86	0.89	0.91	0.93	0.94
Pembrokeshire	4.0%	1.12	4.4%	0.91	0.93	0.95	0.95	0.96
Carmarthenshire	6.0%	1.07	6.4%	1.00	1.00	1.00	1.00	1.00
Swansea	7.9%	0.96	7.6%	1.04	1.03	1.02	1.02	1.01
Neath Port Talbot	4.5%	1.00	4.5%	1.16	1.13	1.10	1.08	1.06
Bridgend	4.6%	0.99	4.6%	1.08	1.07	1.05	1.04	1.03
Vale of Glamorgan	4.2%	1.01	4.2%	0.88	0.90	0.93	0.94	0.95
Cardiff	11.8%	0.84	9.8%	0.98	0.99	0.99	0.99	0.99
Rhondda Cynon Taf	7.6%	0.96	7.3%	1.17	1.14	1.10	1.09	1.07
Merthyr Tydfil	1.9%	0.96	1.8%	1.22	1.18	1.13	1.11	1.09
Caerphilly	5.8%	0.97	5.6%	1.13	1.10	1.08	1.06	1.05
Blaenau Gwent	2.2%	0.99	2.2%	1.23	1.18	1.14	1.11	1.09
Torfaen	3.0%	1.00	2.9%	1.06	1.05	1.04	1.03	1.02
Monmouthshire	3.0%	1.11	3.3%	0.80	0.84	0.88	0.90	0.92
Newport	4.9%	0.92	4.5%	1.01	1.01	1.01	1.01	1.00

Table 2: Comparison of the Local Authority share of growth money under the five options for the additional needs index

				Share of growth money after additional needs					Range in share
Local authority	**Population share**	**Age-sex costs index**	**Age-sex weighted share**	**Option 1**	**Option 2**	**Option 3**	**Option 4**	**Option 5**	Difference from Option 1 *(v. strong additional needs)* to Option 5 *(lower)*
				A 10% increase in additional needs increases relative healthcare need by:					
				10%	*8%*	*6%*	*5%*	*4%*	
Isle of Anglesey	2.2%	1.11	2.5%	2.3%	2.3%	2.4%	2.4%	2.4%	0.1%
Gwynedd	4.0%	1.04	4.1%	3.7%	3.8%	3.8%	3.9%	3.9%	0.3%
Conwy	3.7%	1.16	4.3%	4.1%	4.1%	4.2%	4.2%	4.2%	0.1%
Denbighshire	3.0%	1.07	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	0.0%
Flintshire	4.9%	1.01	5.0%	4.5%	4.6%	4.7%	4.7%	4.8%	0.3%
Wrexham	4.4%	0.98	4.3%	4.2%	4.2%	4.2%	4.2%	4.2%	0.0%
Powys	4.2%	1.16	4.8%	4.0%	4.1%	4.3%	4.4%	4.5%	0.5%
Ceredigion	2.3%	1.08	2.5%	2.2%	2.2%	2.3%	2.3%	2.4%	0.2%
Pembrokeshire	4.0%	1.12	4.4%	4.0%	4.1%	4.2%	4.2%	4.3%	0.2%
Carmarthenshire	6.0%	1.07	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	0.0%
Swansea	7.9%	0.96	7.6%	7.9%	7.8%	7.8%	7.7%	7.7%	-0.2%
Neath Port Talbot	4.5%	1.00	4.5%	5.3%	5.1%	5.0%	4.9%	4.8%	-0.4%
Bridgend	4.6%	0.99	4.6%	5.0%	4.9%	4.8%	4.8%	4.7%	-0.2%
Vale of Glamorgan	4.2%	1.01	4.2%	3.7%	3.8%	3.9%	4.0%	4.0%	0.3%
Cardiff	11.8%	0.84	9.8%	9.7%	9.7%	9.7%	9.8%	9.8%	0.1%
Rhondda Cynon Taf	7.6%	0.96	7.3%	8.6%	8.3%	8.1%	7.9%	7.8%	-0.8%
Merthyr Tydfil	1.9%	0.96	1.8%	2.2%	2.1%	2.1%	2.0%	2.0%	-0.2%
Caerphilly	5.8%	0.97	5.6%	6.3%	6.1%	6.0%	5.9%	5.8%	-0.4%
Blaenau Gwent	2.2%	0.99	2.2%	2.7%	2.6%	2.5%	2.4%	2.4%	-0.3%
Torfaen	3.0%	1.00	2.9%	3.1%	3.1%	3.1%	3.0%	3.0%	-0.1%
Monmouthshire	3.0%	1.11	3.3%	2.7%	2.8%	2.9%	3.0%	3.1%	0.4%
Newport	4.9%	0.92	4.5%	4.6%	4.6%	4.5%	4.5%	4.5%	0.0%

Annex 2: technical summary of further econometric testing

The statistical analysis has been updated following discussion and input from an econometrics professor.

Alternative model specifications tested

The overall model is as described in the Appendix of RAR050. The further work has tested alternative estimation methods. This compares the random effects estimator (as presented in RAR050) to the pooled Ordinary Least Squares (OLS) estimator with and without robust standard errors. The results of pooled OLS provide a useful comparator given the small sample size of the data (7 local health boards over 5 years) as the OLS estimator is known to have small sample properties (e.g. unbiased in small samples).

Following refinement and testing of the model, the independent variable in the model is the additional needs index calculated as the average of the ASMR and LLI indices (in Tables 1(i) – (iii) below). This is in contrast to RAR050, where the coefficient on ASMR is taken as representative of the overall weighting of the needs index to age-sex weighted cost index. The additional needs index is preferred as it explains more of the variance in the model, as seen by the higher R-squared, and is consistent with the agreed approach to capture additional needs in the Growth Formula.

The model with ASMR index only is still reported as a sensitivity (in Tables 2(i) – (iii) below). This sensitivity is included to test whether the estimates are robust to changes in the model specification. As the model considers multiple years of data over which LLI does not vary[38], the sensitivity analysis is carried out to test for any unexpected effects this may have on the regression results (i.e. change to coefficient sign or order of magnitude) when LLI is included in the independent variable.

Results

The coefficient on additional needs is consistently in the range c.0.4 – 0.5 across the estimation methods tested and model specifications. In the core model with the additional needs index, the estimate is between c.0.42 – 0.43 and statistically significant at the 1% level across estimation methods.

The results of the Breusch-Pagan test suggest there is heteroskedasticity (the variance of the error term is not constant), so it is appropriate to use robust standard errors. Heteroskedasticity does not cause bias in coefficient estimates but can make the estimates less precise which can impact on the significance of results. However in this analysis the coefficient under pooled OLS with robust standard errors (which adjusts for heteroskedasticity) remains statistically significant at the 1% level.

The results imply a 10% increase in additional needs is related to around 4 - 5% increase in relative healthcare need of the population.

[38] LLI is based on census data from 2011.

6.1.1. Tables

Tables 1(i) - (iii) relate to the sensitivity using the additional need index as is (the average of the LLTI index and ASMR index). The model is given by the formula:

$$\frac{Share\ of\ actual\ expenditure_{i,t}}{Share\ of\ age\ sex\ weighted\ expected\ cost_{i,t}} = c + \beta \times \left(\frac{LLTI\ index_i + ASMR < 75\ index_{i,t}}{2}\right) + \varepsilon_{i,t}$$

The share of actual expenditure is based on health finance data for LHB secondary services to reflect as best as possible hospital and community healthcare services which are within scope of the Growth Formula. However, this may include some ring-fenced services which are delivered in secondary care, for example mental health.

Tables 2(i) - (iii) relate to the model specification using ASMR as representative of the overall additional needs index. The model is given by the formula:

$$\frac{Share\ of\ actual\ expenditure_{i,t}}{Share\ of\ age\ sex\ weighted\ expected\ cost_{i,t}} = c + \beta \times ASMR < 75\ index_{i,t} + \varepsilon_{i,t}$$

$$where\ i\ is\ the\ Local\ Health\ Board\ and\ t\ is\ the\ year$$

Table 1(i): Average LLTI + ASMR index – Random effects with unadjusted standard errors

RandomEffects Estimation Summary

Dep. Variable:	Relative_need	R-squared:	0.3027
Estimator:	RandomEffects	R-squared (Between):	0.7340
No. Observations:	35	R-squared (Within):	0.0052
Date:	Thu, Aug 15 2019	R-squared (Overall):	0.6806
Time:	18:07:46	Log-likelihood	96.232
Cov. Estimator:	Unadjusted		
		F-statistic:	14.328
Entities:	7	P-value	0.0006
Avg Obs:	5.0000	Distribution:	F(1,33)
Min Obs:	5.0000		
Max Obs:	5.0000	F-statistic (robust):	14.328
		P-value	0.0006
Time periods:	5	Distribution:	F(1,33)
Avg Obs:	7.0000		
Min Obs:	7.0000		
Max Obs:	7.0000		

Parameter Estimates

	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
const	0.5886	0.1102	5.3418	0.0000	0.3644	0.8128
needs index	0.4167	0.1101	3.7852	0.0006	0.1927	0.6406

Table 1(ii) Average LLTI + ASMR index – Pooled OLS, unadjusted standard errors

PooledOLS Estimation Summary

Dep. Variable:	Relative_need	R-squared:	0.6811
Estimator:	PooledOLS	R-squared (Between):	0.7345
No. Observations:	35	R-squared (Within):	0.0045
Date:	Thu, Aug 15 2019	R-squared (Overall):	0.6811
Time:	18:07:46	Log-likelihood	73.343
Cov. Estimator:	Unadjusted		
		F-statistic:	70.466
Entities:	7	P-value	0.0000
Avg Obs:	5.0000	Distribution:	F(1,33)
Min Obs:	5.0000		
Max Obs:	5.0000	F-statistic (robust):	70.466
		P-value	0.0000
Time periods:	5	Distribution:	F(1,33)
Avg Obs:	7.0000		
Min Obs:	7.0000		
Max Obs:	7.0000		

Parameter Estimates

	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
const	0.5780	0.0509	11.346	0.0000	0.4744	0.6816
needs index	0.4273	0.0509	8.3944	0.0000	0.3238	0.5309

Breusch-Pagan Test

LM statistic	P-value	F-statistic	P-Value
11.251989621131685	0.0007953771310792645	15.635653327310035	0.00038310465351126523

Table 1(iii): Average LLTI + ASMR index – Pooled OLS, robust standard errors

PooledOLS Estimation Summary

Dep. Variable:	Relative_need	R-squared:	0.6811
Estimator:	PooledOLS	R-squared (Between):	0.7345
No. Observations:	35	R-squared (Within):	0.0045
Date:	Thu, Aug 15 2019	R-squared (Overall):	0.6811
Time:	18:07:46	Log-likelihood	73.343
Cov. Estimator:	Robust		
		F-statistic:	70.466
Entities:	7	P-value	0.0000
Avg Obs:	5.0000	Distribution:	F(1,33)
Min Obs:	5.0000		
Max Obs:	5.0000	F-statistic (robust):	42.968
		P-value	0.0000
Time periods:	5	Distribution:	F(1,33)
Avg Obs:	7.0000		
Min Obs:	7.0000		
Max Obs:	7.0000		

Parameter Estimates

	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
const	0.5780	0.0623	9.2715	0.0000	0.4512	0.7048
needs index	0.4273	0.0652	6.5550	0.0000	0.2947	0.5600

Breusch-Pagan Test

LM statistic	P-value	F-statistic	P-Value
11.251989621131685	0.0007953771310792645	15.635653327310035	0.00038310465351126523

Sensitivity results

Table 2(i): ASMR index – Random effects, unadjusted standard errors

RandomEffects Estimation Summary

Dep. Variable:	Relative_need	R-squared:	0.2019
Estimator:	RandomEffects	R-squared (Between):	0.6298
No. Observations:	35	R-squared (Within):	-0.0387
Date:	Thu, Aug 15 2019	R-squared (Overall):	0.5809
Time:	17:57:54	Log-likelihood	95.244
Cov. Estimator:	Unadjusted		
		F-statistic:	8.3462
Entities:	7	P-value	0.0068
Avg Obs:	5.0000	Distribution:	F(1,33)
Min Obs:	5.0000		
Max Obs:	5.0000	F-statistic (robust):	8.3462
		P-value	0.0068
Time periods:	5	Distribution:	F(1,33)
Avg Obs:	7.0000		
Min Obs:	7.0000		
Max Obs:	7.0000		

Parameter Estimates

	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
const	0.6223	0.1326	4.6951	0.0000	0.3527	0.8920
ASMR index	0.3832	0.1326	2.8890	0.0068	0.1133	0.6530

Table 2(ii): ASMR index – Pooled OLS, unadjusted standard errors

PooledOLS Estimation Summary

Dep. Variable:	Relative_need	R-squared:	0.6176
Estimator:	PooledOLS	R-squared (Between):	0.6739
No. Observations:	35	R-squared (Within):	-0.0963
Date:	Thu, Aug 15 2019	R-squared (Overall):	0.6176
Time:	18:02:02	Log-likelihood	70.165
Cov. Estimator:	Unadjusted		
		F-statistic:	53.286
Entities:	7	P-value	0.0000
Avg Obs:	5.0000	Distribution:	F(1,33)
Min Obs:	5.0000		
Max Obs:	5.0000	F-statistic (robust):	53.286
		P-value	0.0000
Time periods:	5	Distribution:	F(1,33)
Avg Obs:	7.0000		
Min Obs:	7.0000		
Max Obs:	7.0000		

Parameter Estimates

	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
const	0.4996	0.0693	7.2137	0.0000	0.3587	0.6405
ASMR index	0.5066	0.0694	7.2997	0.0000	0.3654	0.6478

Breusch-Pagan Test

LM statistic	P-value	F-statistic	P-Value
(9.573152313318731,	0.0019744346488076506,	12.424427527640235,	0.0012665813896876059)

Table 2(iii): ASMR index – Pooled OLS, robust standard errors

PooledOLS Estimation Summary

Dep. Variable:	Relative_need	R-squared:	0.6176
Estimator:	PooledOLS	R-squared (Between):	0.6739
No. Observations:	35	R-squared (Within):	-0.0963
Date:	Thu, Aug 15 2019	R-squared (Overall):	0.6176
Time:	18:01:52	Log-likelihood	70.165
Cov. Estimator:	Robust		
		F-statistic:	53.286
Entities:	7	P-value	0.0000
Avg Obs:	5.0000	Distribution:	F(1,33)
Min Obs:	5.0000		
Max Obs:	5.0000	F-statistic (robust):	32.491
		P-value	0.0000
Time periods:	5	Distribution:	F(1,33)
Avg Obs:	7.0000		
Min Obs:	7.0000		
Max Obs:	7.0000		

Parameter Estimates

	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
const	0.4996	0.0860	5.8093	0.0000	0.3246	0.6745
ASMR index	0.5066	0.0889	5.7000	0.0000	0.3258	0.6875

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